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THE OPERATIONS OF AURAL SURGERY

TOGETHER WITH THOSE
FOR THE RELIEF OF THE INTRACRANIAL
COMPLICATIONS OF SUPPURATIVE
OTITIS MEDIA

BY

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WITH ILLUSTRATIONS

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PREFACE

Our thanks are due to Mr. D. M. Stone for his valuable help in the preparation of the plates, to the making of the photographs for which he devoted unlimited patience and the resources of a wide experience; to the maker of the plates for his technical skill and care; and to the publishers for much consideration and cordial co-operation in carrying out the ideas of the authors with regard to typography and illustration.

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THE OPERATIONS OF AURAL SURGERY

INTRODUCTION

In writing this book we have felt some doubt whether its intention and purposed scope will always be correctly apprehended by its readers, and we therefore make no apology for prefacing the book proper by a short chapter which may explain our objects, and may at the same time serve to supply exact information on certain matters, which, while they do not fall within the scope of the operative chapters, must still be correctly grasped, if some of the indications for operative interference are to be intelligently followed.

While the number of the books in English devoted to the diseases of the ear has rapidly increased of recent years, so that the student or practitioner has now a wide choice of sufficiently adequate handbooks for his general guidance, we have felt that neither in these nor in the larger works is the subject of operative procedures dealt with in anything like the detail which it deserves.

Moreover, we have elaborated in our own practice a number of methods which are, we think, new, and which we have found of such value by actual experience that we have taken this method of introducing them to others. Finally, we have felt the want of an account of the methods which we ourselves follow for the use of our students and house-surgeons.

The substance of the book is the formulation of personal experience; we have not gone outside this source for anything embodied in it. We can therefore answer any who may doubt the value of some of the procedures which are described with the simple reply that all have been tested and found of value, and that nothing has been stated which has not been most thoroughly weighed against the results of clinical experience. We have made no attempt to describe any procedure with which we are not personally familiar, and have thus excluded those minor tympanic operations which find so large a representation in most textbooks, and are so exceedingly rarely put to the test of application. Our aim in writing the book has been to make an addition to the literature of aural surgery which should embody information at first hand, in the hope that so there might attach to it some permanent value, however small.

Included in the contents are several procedures which have not as yet been generally adopted by aural surgeons. The **operations on the labyrinth** in their systematized form were introduced to the Otological Section of the Royal Society of Medicine in a paper read by the authors in March, 1908; since that date there has been a marked tendency to the adoption of the procedures and terminology then advocated, and the "vestibulotomies" have taken their place among the recognized operations of aural surgery as practised by many English otologists. While there may still be felt some doubts as to the precise limits within which operation on the labyrinth may be desirable, we look forward with confidence to the increasing recognition of the importance of the conditions dealt with, and to the more ready application of surgical methods for their relief. The operations for the **drainage of the meninges** are put forward more tentatively on account of the smaller number of the cases in which we have had the opportunity of giving them trial. We have, however, been encouraged by the measure of success which has rewarded their application to hope that by such means a proportion of the cases of otitic meningitis may be saved by prompt operation, and that a condition hitherto beyond cure may be rendered amenable to treatment.

While strongly convinced of the value of the operations set forth, we should feel amply rewarded if the only result were the stimulation of others to the discovery of some quite different and more efficient method of treatment. The acceptance of meningitis as a condition not admitting of any but palliative treatment cannot but be regarded as an attitude which is discreditable in so rapidly advancing a branch of surgery as that of the ear.

There is nothing essentially new in **the operation for early carcinoma of the meatus.** We have, however, had the opportunity of operating on a remarkable series of cases, during which the procedure has standardized itself on the lines laid down. We have found it of service to have a definite plan of operation to work on ourselves, and think that no important changes are likely to be necessary in the future. We have found the results of carefully systematized operation on malignant disease to be very gratifying, and are inclined to regard epithelioma of the external meatus as a relatively hopeful form of cancer if the primary disease has not spread beyond the reach of reasonable surgery. Even in some obviously hopeless cases much relief and temporary freedom from pain and ulceration may be given to the patient, as in the case quoted in Appendix, under No. 47.

While in nearly all cases the operation area is already infected more or less grossly before the surgeon comes to it, there is no department of operative work which more generously repays a thorough **asepsis** than that of the ear. The explanation of this lies in the acquisition of a high degree of local immunity to the organisms already present. The tissues are able to prevent the penetration of the organisms to which they have become habituated, and, if drainage is adequate, the incision of an aseptically conducted radical operation may be trusted to heal after the manner of an uninfected wound. On the other hand, any lapse from strict asepsis is apt to be followed by suppuration, which may be of the most violent type if a virulent organism has been imported at the time of the operation.

It should never be forgotten that the power of resistance applies to those organisms only which have by their continued presence called up an increased degree of resistive power, and that the foulness of an abscess is no palliation for the blunder of importing a new infection. As a matter of personal experience, we are in favour of the performance of the local preparation of the patient on the operating-table; but if it be adequately carried out, this matters little. We strongly advocate the use of rubber gloves, especially when more than one operation is to be done in series. The difficulty of avoiding the carrying over of infection from one patient to the next is otherwise almost insuperable. If gloves are used on which the natural grain of the skin is imitated, there will be found no added manipulative difficulties which a little practice will not overcome.

We gladly acknowledge our debt to the skill and patience of the many anæsthetists who have helped us at various times. To those who possess special experience in the **administration of anæsthetics** the remarks under this heading in the various operations will convey nothing that is new. It often, however, falls to the lot of the comparatively inexperienced to administer anæsthetics in emergency, and we hope that the suggestions made as to the choice of agent may be of use to those thus situated. The task of the anæsthetist is often a weary and, we fear, an ungrateful one. The operations are necessarily in many cases prolonged and, to the bystander, uninteresting; yet the anæsthetist must be continually on the strain to watch for the slightest indication of interference with the facial nerve, in addition to his other anxieties. The vast majority of cases manifest no unpleasant features from the anæsthetist's point of view; in operations on the brain he will naturally be on the watch for the obvious danger of cessation of respiration. Sudden and alarming collapse sometimes occurs, especially in operations on the tympanum conducted through the meatus.

NYSTAGMUS.

We have found certain special examinations of great value to ascertain normal and abnormal states of the labyrinth.

During the last twelve months particularly we have proved the usefulness of rhythmic nystagmus of labyrinthine origin in so many cases that we regard certain responses to stimulation as being indicative of an intact and functional labyrinth, and certain abnormal responses or failure of response to stimulation as indicating partial or complete disorganization of the labyrinth. As we have elsewhere mentioned, Mr. Tweedie, of Nottingham, after a visit to Bárány's clinic, drew our attention to the existence of reflex nystagmus of labyrinthine origin. The actual technique of the observations we have made has been evolved from numerous independent experiments, both on individuals whose labyrinths we have had opportunities of proving to be free from disease, and on others in whom labyrinthine disease has been subsequently disclosed by operation or histological examination.

Rotation.—The patient is seated, with the head erect and eyes closed, upon an easily rotating chair. The chair is rotated slowly at the rate of one complete revolution in five seconds. After three revolutions the patient is directed to open the eyes, and to fix them in extreme deviation towards the side from which rotation has been made, and afterwards towards that to which rotation has been made. If no nystagmus is provoked by three revolutions, five revolutions are made.

Normal Responses.—Rhythmic nystagmus will be elicited when the head is kept erect and the eyes are deviated to the side from which rotation has been made; there will be no nystagmus when the eyes are turned to the side towards which rotation has been made.

The nystagmus is horizontal, and is characterized by a quick movement towards the side of deviation, with a slow return. The duration of nystagmus after rotation has ceased is generally limited to about twenty seconds.

EXAMPLE.—When the head is kept erect and the eyes closed, and the chair is rotated clockwise, nystagmus will be produced by turning the eyes to the left, and there will be no nystagmus when the eyes are turned to the right.

Abnormal Responses.—In some cases of unilateral disease of the labyrinth, spontaneous nystagmus may be present at the time of examination. In other cases there is no spontaneous nystagmus — *i.e.*, nystagmus elicited by deviation without applied stimulation—at the time of examination. In adults with long-standing labyrinthine disease there may be no nystagmus. Children lose spontaneous nystagmus in a few days after disorganization of the labyrinth.

In cases of unilateral disease of the labyrinth in which there is no spontaneous nystagmus at the time of examination, it is impossible after rotation towards the unaffected side to elicit nystagmus by deviation of the eyes either to one side or the other, provided that the rotations are limited to three revolutions, and are not faster than one revolution in five seconds. In referring to the rotation test in our paper on labyrinthine surgery in March, 1908, we said our results of its application had been somewhat at variance. At that time we were subjecting the patient to ten revolutions, and we expressed as our opinion of the test then performed—that it was one "which would probably prove of extreme value as affording definite objective signs of suspected labyrinthine lesions; but we were unable at that time to do more than accept an abnormal response as presumptive evidence of a disordered labyrinth."

At the present time we feel we can supplement this statement after a more extended experience of the test, the technique of which we have varied in many ways. We varied the position of the head, rate of rotation, and number of revolutions, and made records of the results obtained under these different conditions.

As we have said, the rate of rotation should not, as a rule, exceed one revolution in five seconds, and the number of revolutions in one direction should not exceed three. For clinical purposes it is sufficient if the observations are made with the patient's head in one position only—namely, erect. It should also be noticed that all patients even with normal labyrinths do not respond in precisely the same degree of intensity.

Those cases in which unilateral spontaneous nystagmus is present at the time of examination give different responses to the rotation tests according to the cause of the spontaneous nystagmus, whether due to a partially diseased or a completely disorganized membranous labyrinth.

In the case of destruction of the membranous labyrinth, spontaneous nystagmus, when present, is seen when the eyes are deviated to the unaffected side. Its type is generally combined horizontal and rotatory, and it is sometimes associated with much finer rotatory nystagmus, sometimes difficult to recognize, upon deviation of the eyes to the affected side.

In the case of a partially functional labyrinth irritated by disease, the spontaneous nystagmus is not quite so characteristic. It is less frequently observed. We have found spontaneous nystagmus on deviation of the eyes to the affected side to be associated with a fistula through the bony wall of the external ampulla and intact membranous labyrinth. We have also met with spontaneous nystagmus to the affected side in a case of destructive disease of the labyrinth, complicated with an intracerebellar abscess on the same side. (See Appendix, Case 22.)

EXAMPLE of the effect of rotation in a case of unilateral spontaneous nystagmus toward the unaffected side.

Suppose a case of nystagmus to the left, due to destruction of the right labyrinth: after rotation thrice to the left (*i.e.*, counter-clockwise), no nystagmus will be elicited when the head is kept erect and the eyes turned to the right (*i.e.*, to the affected side); the spontaneous nystagmus to the left may be temporarily arrested or diminished. After rotation thrice to the right (*i.e.*, clockwise), the spontaneous nystagmus to the left (*i.e.*, to the unaffected side) may be slightly increased, and there will be no nystagmus on deviation to the right.

EXAMPLE of the effect of rotation in a case of unilateral spontaneous nystagmus towards the affected side.

In a case of nystagmus to the right, due to a fistula of the right bony labyrinth with a partially intact membranous labyrinth, we noticed that rotation thrice to the left produced no effect on the spontaneous nystagmus which remained on deviation of the eyes to the right, and there was no nystagmus with deviation to the left. After rotation to the right, nystagmus was elicited on deviation of the eyes to the left, and ceased temporarily on deviation to the right—that is, the results of rotation were apparently normal. (See Caloric Tests.) Three days later there was spontaneous nystagmus on deviation to the left, and no nystagmus upon deviation to the right. The results of rotation were now the same as those obtainable in a case of unilateral nystagmus toward the unaffected side. An ampullary fistula was found at the operation on this day.

For purposes of physiological research, we have performed rotation with the head in other attitudes; but for clinical purposes, observations made with the head in the erect position are, as a rule, sufficient.

Caloric Nystagmus.—It was not until December, 1907, that we ourselves observed that giddiness in a patient after syringing the ear was associated with definite nystagmus on deviation of the eyes. At the time we presented the results of our experience in labyrinthine surgery, we had placed no reliance upon caloric tests, and it was only after applying the tests in a large series of cases and studying the various results obtained that we came to regard this method of examination as of undoubted importance.

TECHNIQUE.—Cool water—temperature about 70° F.—is allowed to flow into the external auditory meatus of the patient from a syringe, or from an irrigator, in such a way that no pressure sensations are produced, and the flow is continued for a minute or longer, to allow the cooling influence of the fluid to act upon the labyrinth.

When the head is erect, if the labyrinth is intact, rotatory nystagmus downwards and outwards is produced upon deviation of the eyes to the opposite side. If the head is bowed forwards, so that the face looks downwards, horizontal nystagmus is produced upon deviation of the eyes to the affected side.

The explanation of the phenomena, so far as the labyrinth is concerned, can be definitely accepted, and we believe it to be as follow: When the head is erect and one labyrinth is cooled, gravitation currents cause mass movement of the cooler and denser endolymph downwards from the superior ampulla into the utricle, passing the hair cells of the superior crista, the fibrillæ of which are deflected towards the utricle. This deflection of the fibrillæ downwards towards the utricle gives rise to impulses, which are conveyed by the superior ampullary nerves, and set up the reflex rhythmic nystagmus.

Nystagmus, which is provoked by impulses conveyed by the superior ampullary nerve, is rotatory in type. When the agent employed produces deflection of the fibrillæ from the superior ampulla towards the utricle, the nystagmus is elicited upon deviation of the eyes toward the non-stimulated side. When the fibrillæ are deflected from the utricle towards the superior ampulla (for instance, by complete inversion of the head), the eyes must be deviated towards the stimulated side to induce the resulting nystagmus to appear. When the head is bowed so that the face looks directly downwards, after the labyrinth is cooled, the gravitation currents in the endolymph flow from the external ampulla into the utricle, passing the hair cells of the external crista, and cause deflection of the fibrillæ towards the utricle. The deflection of these fibrillæ gives rises to impulses, which are conveyed by the external ampullary nerve towards the oculomotor centres, causing nystagmus which is horizontal in type. When the deflection of the fibrillæ is forwards from the external ampulla towards the utricle, the resulting nystagmus is induced by deviating the eyes toward the stimulated side; whereas when the fibrillæ of the external crista are deflected from the utricle toward the external ampulla—for instance, when the face is looking directly upwards—the nystagmus is induced by deviating the eyes to the non-stimulated side.

Example.—A normal individual is seated with head erect on a flat couch, while, let us say, the right ear is syringed gently with several syringefuls of cool water (70° F.). After continued syringing for a minute or more, the cooling is followed by rotatory nystagmus, which is elicited by deviation of the eyes to the left side, but which is arrested when the eyes are deviated to the right side. Syringing is discontinued, and the subject is made to lie flat on the back, so that the head can be inverted over the end of the couch. Immediately inversion of the head takes place, the nystagmus towards the left side is arrested, and rotatory nystagmus is produced by deviation of the eyes to the right. After resuming the erect position, the nystagmus returns with deviation of the eyes to the left, and is arrested by deviation to the right. If instead of cool water we use hot to heat the endolymph, the direction of the convection currents is reversed, and this explains how it is that the direction of the resulting nystagmus is reversed when hot water is used instead of cold.

We have carried out a number of observations with water at various temperatures above and below the temperature of the body up to the limits of toleration, and conclude that for clinical purposes the temperature of the water need not, as a rule, be below 70° F. The more exposed the inner wall of the middle-ear cavity is to the influence of changes in temperature, the more readily are the effects of cooling produced; a temperature only 10 degrees below that of the blood may sometimes be sufficient to evoke the phenomena described.

If the physical results of rotation currents on the deflection of the fibrillæ of the hair cells are compared with the physical effects of gravitation convection currents on the fibrillæ, the direction of the deflection will be found to correspond when the same type of nystagmus is concerned—that is to say, it matters not whether the fibrillæ are deflected by rotation or by convexion currents; the type of nystagmus depends upon the direction of deflection.

Hence rotation and caloric tests are essentially one and the same in the character of the stimulus—namely, fibrillar deflection.

As regards abnormal and absent responses, we think it is sufficient to say that any agent interfering with deflection of the ampullary fibrillæ—for instance, diffuse infection of the labyrinth, invasion of the membranous labyrinth by granulations, destruction of the labyrinth, necrosis, or interference with its blood-supply—is sufficient cause in the labyrinth to account for absence of reflex nystagmus. It is perhaps well to observe that if the meatus or tympanum contains material which interrupts the conduction of thermal changes to the endolymph, it is not possible for the normal nystagmus reflexes to be demonstrated. Therefore, the presence of granulations, polypi, cerumen, scar tissue, or stenosis must be ascertained before concluding that absence of response to thermal influences indicates labyrinthine disease. Absent responses may also be due to some interruption in the paths of the brain or oculo-motor nerves which comprise the reflex arc.

Electrical Stimulation.—We have not been impressed with the clinical usefulness of electrical stimulation in evoking nystagmus so far as the labyrinth is concerned. We have found it possible to produce nystagmus by means of galvanism in cases in which the membranous labyrinth was known to be deficient—*e.g.*, after operation. We arrived at the tentative conclusion that electrical stimuli may be transmitted direct to the ampullary nerves without the intervention of the special end-organs; so that normal results to electrical stimulation do not necessarily exclude disease of the cristæ and membranous labyrinth. For these reasons, and for want of more extended experience with galvanic stimulation, we withhold any further statement regarding the technique which we have employed.

Compression.—In cases of normal labyrinth, compression of the air in the meatus by sudden pressure upon the tragus with the finger does not cause vertigo or nystagmus. In a patient with a fistula in some part of the outer bony wall of the labyrinth, provided the utricle and ampullæ are not completely disorganized, violent vertigo and mixed forms of nystagmus may be evoked by compression, and the patient may suddenly fall. The phenomenon can be explained upon the hypothesis of deflection currents set up by the sudden compression, which is transmitted through the soft tissues which occupy the fistula in the bone. No vertigo or nystagmus can be produced by compression when the labyrinth is totally disintegrated or functionless, even though a fistula is present.

ROMBERGISM.

The presence of this well-known sign must be taken into consideration with other phenomena. The patient stands with eyes closed, first on both feet together, then on each foot separately. In many cases of disease of the labyrinth, especially when recent, the patient is quite unable to stand steadily, and often falls when he shuts his eyes. Though not to be taken as direct evidence of a disordered labyrinth, this test is valuable when taken in conjunction with other signs. Rombergism is absent—that is, the patient is able to remain perfectly steady on both feet with closed eyes—in cases of long-standing disease of the labyrinth in adults, and the sign disappears early in children.

Some patients with labyrinthine defects can stand with eyes closed when both feet are placed upon the ground, but are unable to do so when one or other foot is raised. As a rule, they are least certain when standing on the foot of the affected side.

GAIT.

Patients with affections of the labyrinth of recent onset are invariably uncertain in gait. Often with the eyes open, and always when they are closed, there is a tendency to deviate towards the affected side, though this may be over-corrected by an obvious effort of readjustment.

In the attempt to walk along a straight line and to secure stability, the feet are placed wider apart than is normal, and in some cases we have observed marked ataxic gait. A sudden movement of the head when marching may cause the patient to reel; he may fall, and, unless prevented, may hurt himself.

Von Stein's Tests.—We have made repeated use of Von Stein's tests for instability in the execution of certain unusual movements, which demand precise co-ordinate control of posture. For example, jumping, hopping forwards, backwards, and sideways with eyes (1) open, (2) closed. In cases of recent labyrinthine disease, these movements cannot be performed on account of the unsteadiness of the patient when he attempts to execute them. The explanation of Rombergism, deviating gait, and inability to execute Von Stein's tests is based upon other functions of the labyrinth than those which can be explained by deflection stimuli.

CHAPTER I

INCISION OF A FURUNCLE IN THE EXTERNAL AUDITORY MEATUS

FURUNCLES are generally situated in the walls of the cartilaginous meatus, or on the inner surface of the tragus. In the former situation they may be among the most painful affections of the ear. Furuncles often occur in the course of chronic suppurative otitis media.

Indications for the Operation.—An incision should be made—(1) if the swelling in the outer part of the meatus evidently contains pus; (2) if swelling and tenderness increase in spite of the escape of pus; and (3) if the swelling in the outer part of the meatus is diffuse and accompanied by severe pain, unrelieved by hot fomentations or ice-pack.

General Preparation of the Patient.—In the case of very painful deep-seated furuncles, the patient should be prepared for nitrous oxide anæsthesia.

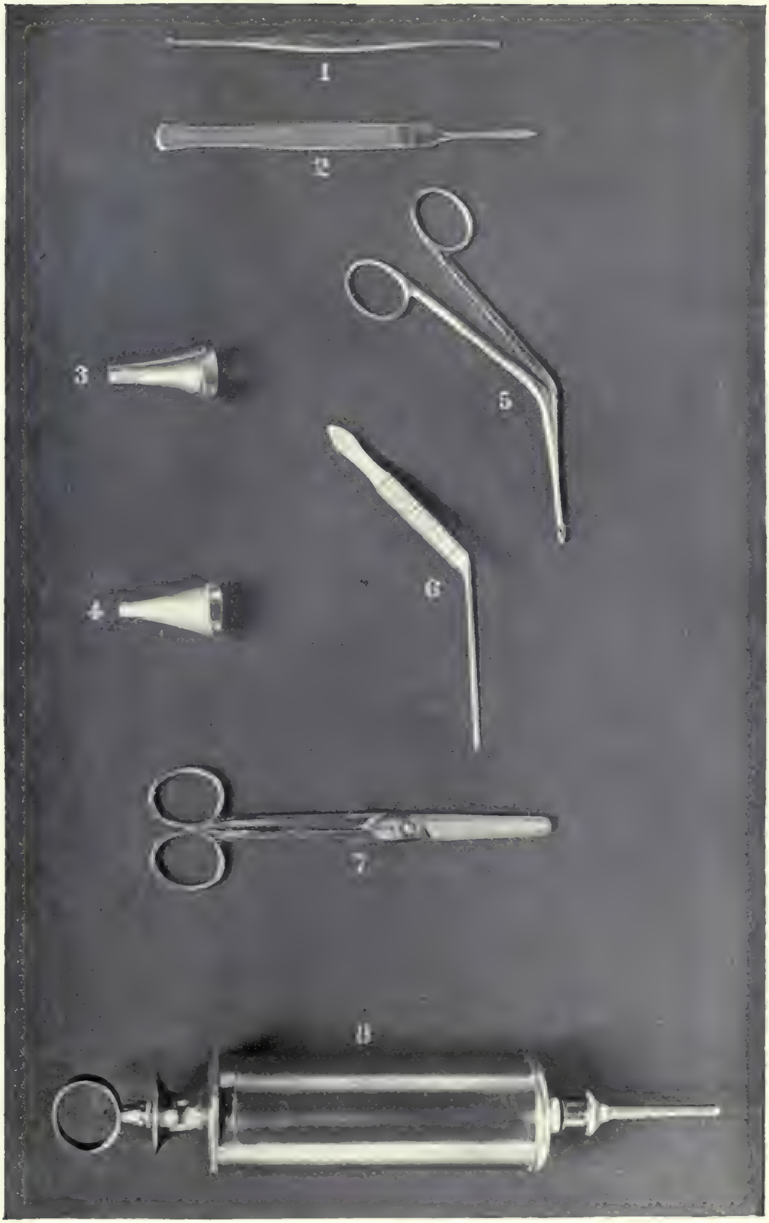
Local Preparation of the Patient.—The pinna should be cleansed with ether and biniodide of mercury lotion (1 in 1,000 aqueous).

Anæsthetic.—For the very painful deep-seated furuncles nitrous oxide gas should be administered. For small superficial furuncles the following mixture may be used as a local anæsthetic. It is applied to the meatus on a pledget of wool, or in the form of drops. The mixture is allowed to remain in contact with the skin for about

INSTRUMENTS FOR THE INCISION OF A FURUNCLE IN THE EXTERNAL AUDITORY MEATUS.

1. Small spoon curette.
2. Small sharp-pointed knife.
3. Operating speculum.
4. Aural speculum, ordinary pattern.
5. Small Hartmann's forceps.
6. Aural forceps.
7. Scissors.
8. Syringe.

Plate I.



INSTRUMENTS FOR THE INCISION OF A FURUNCLE IN THE EXTERNAL AUDITORY MEATUS.

To face page 16.

seven minutes. At first the drops may cause rather severe smarting.

*Cocain. hydrochlor.	2 parts.
Acid. carbol. liq.	1 part.
Menthol	2 parts.
Rectified spirit	20 parts.

Surgeon's Outfit:

Head-light.
Syringe.
Bowl.
Operating speculum.
Aural forceps.
Small sharp-pointed knife.
Small spoon curette.
Absorbent wool.
Cyanide gauze strip.
Pure liquefied carbolic acid.
Lint—fomentation.
Bandage.
Two sterilized towels.
Platinum-wire loop.
Dissecting forceps.
Spirit-lamp.
Agar culture-tube.

Operative Tactics.—The patient should be anæsthetized in the recumbent position. A small pillow is placed beneath the head and shoulders. A sterilized towel is pinned around the forehead and occiput, and another towel should be spread over the neck and shoulder.

The operator must see to the arrangement of details of procedure before the patient is anæsthetized.

The instruments, sterilized by boiling in the usual way, are placed in a tray on the right-hand side of the surgeon.

* If preferred, a mixture of the first three ingredients may be applied direct.

Technique.—As soon as the patient is anæsthetized, the special speculum is inserted into the meatus with the fenestra on the side to be incised. The incision must be deep enough to let out pus or slough. An agar culture-tube should be inoculated with the material removed. The cavity of the furuncle should be curetted, and after being dried out, swabbed over with a very small application of pure carbolic acid, care being taken to avoid any contact of the acid with the skin. The meatus is syringed with lotion, and a strip of gauze, moist with lotion, is inserted loosely into the meatus.

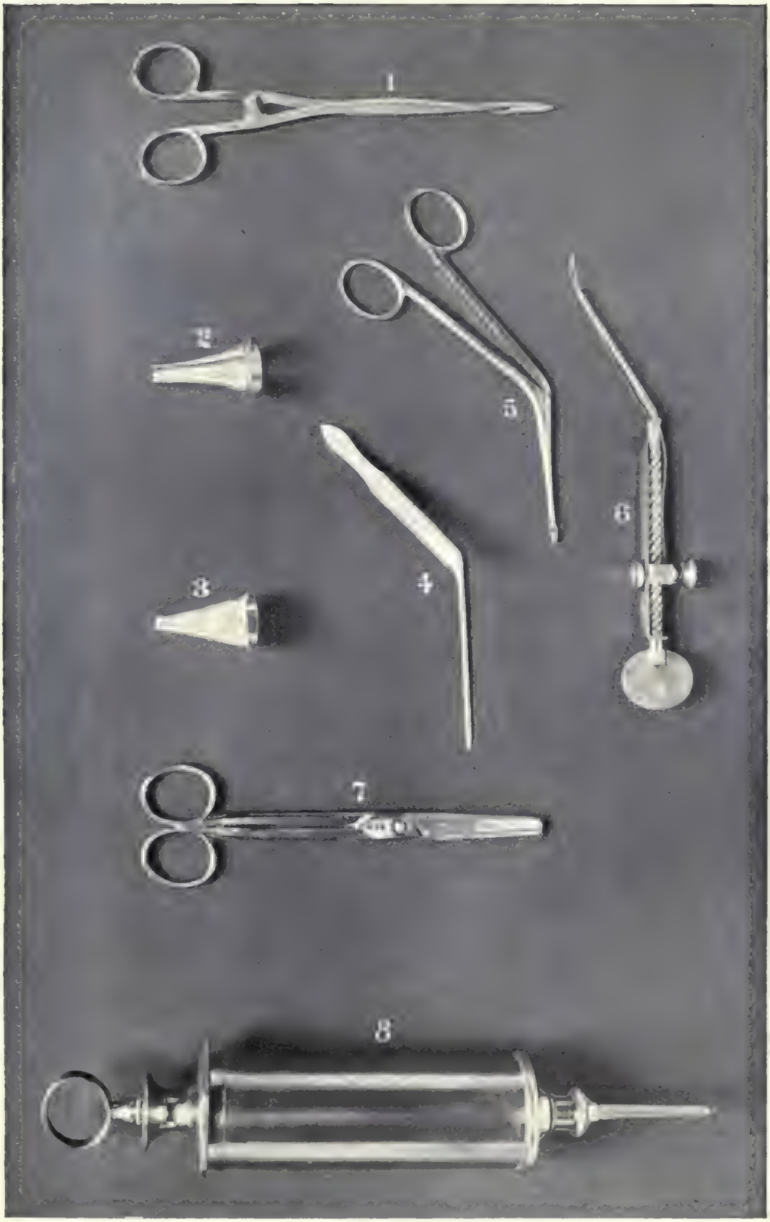
As soon as the patient regains consciousness, a hot fomentation is applied, the lint and wool being secured with an occipito-frontal roller bandage.

After-Treatment.—As a rule, the patient is best in bed. The bowels should be freely opened. The fomentations are changed every two or four hours, according to the relief they afford. After eight or twelve hours the gauze strip is withdrawn. The meatus is syringed with biniodide of mercury lotion, 1 in 4,000, dried and insufflated with boracic powder. After twenty-four hours the meatus is syringed three times a day, until the swelling has subsided and the incision has healed.

INSTRUMENTS FOR THE REMOVAL OF A POLYPUS.

1. Polypus forceps.
2. Operating aural speculum.
3. Aural speculum, ordinary pattern.
4. Aural forceps.
5. Hartmann's forceps.
6. Polypus snare.
7. Scissors.
8. Syringe.

Plate II.



INSTRUMENTS FOR THE REMOVAL OF A POLYPUS.

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CHAPTER II

THE OPERATION FOR REMOVAL OF AURAL POLYPI

THE most convenient and usual method of removing an aural polypus is with the wire snare. It is used in such a way that the pedicle of the growth is cut through by compression as close to its attachment as possible. Sometimes polypi can be easily detached by syringing; in other cases they can be grasped with polypus forceps and removed by torsion. Small polypi are readily and effectively destroyed by the application of chromic acid.

Indications.—The presence of an aural polypus is sufficient indication for its removal. Aural polypi are to be regarded as masses of infected connective tissue originating in the mucosa of the middle ear. A polypus must not be confounded with an exostosis of the meatus, with granulations at the mouth of a masto-meatal fistula, or with an extremely bulging tympanic membrane. Examination with a probe passed round the growth, and careful exploration of a possible fistula with a small bent seeker, should determine the nature of the case.

The polypus may have a wide or narrow attachment to the walls of the tympanum, to the ossicles, to the tympanic ring, or to the margins of a perforation in the tympanic membrane.

Surgeon's Outfit:

Polypus snare.
Soft copper wire (0·5 millimetre diameter).

Light and head mirror.
Syringe.
Fine silver probe.
Aural speculum.
Aural wool forceps.
Hartmann's forceps.
Polypus forceps.
Cyanide ribbon gauze, $\frac{3}{4}$ inch width.
Biniodide of mercury lotion (1 in 2,000).
Chromic acid.
Absorbent wool.
Towel.

Operative Tactics.—The ear having been syringed with mercuric biniodide lotion and dried with wool, the patient is seated with the affected ear towards the operator. An assistant stands on the opposite side and steadies the head.

The snare is tested to ascertain that the wire is properly fixed and adjusted. The wire is drawn out into an oval loop, with the short diameter of the oval just wide enough to pass over the polypus. The loop is bent somewhat forwards and downwards to adapt it to the shape of the canal and the obliquity of the tympanic ring, the upper and anterior limb of the loop being slightly longer than the lower limb, and so curved that it can be passed deeper into the meatus along the anterior wall. The length of the loop should be about $\frac{1}{2}$ inch.

The loop is passed gently, with a slight rotatory motion, over the polypus along the floor and anterior wall of the meatus. As the loop advances, the end of the cannula will enter the upper and posterior part of the canal. When the loop has come to rest upon the anterior margin of the tympanic ring, the instrument must be held very steadily while the wire is tightened and the polypus cut through. As the snare is withdrawn, it carries the growth with it. The meatus is syringed with warm lotion and dried, and the base of the growth is insufflated with boric acid powder. If other polypi have come into view, or if the base of the original polypus be large, chromic acid is applied with wool on aural forceps. A strip of gauze is introduced into the fundus of the meatus, and a small pad of wool placed in the concha.

In all cases treatment should be continued on the usual lines for chronic suppurative otitis media, until the suppuration has ceased.

In some cases the removal of the polypus is followed by rapid healing and cessation of suppuration. (See Indications for the Radical Operation.)

CHAPTER III

MYRINGOTOMY

Definition. — Myringotomy may be defined as "linear incision of the membrana tympani." It may take the form of a stabbed wound (paracentesis) or of a lengthened incision.

Indications.—In the course of an acute or subacute otitis media:

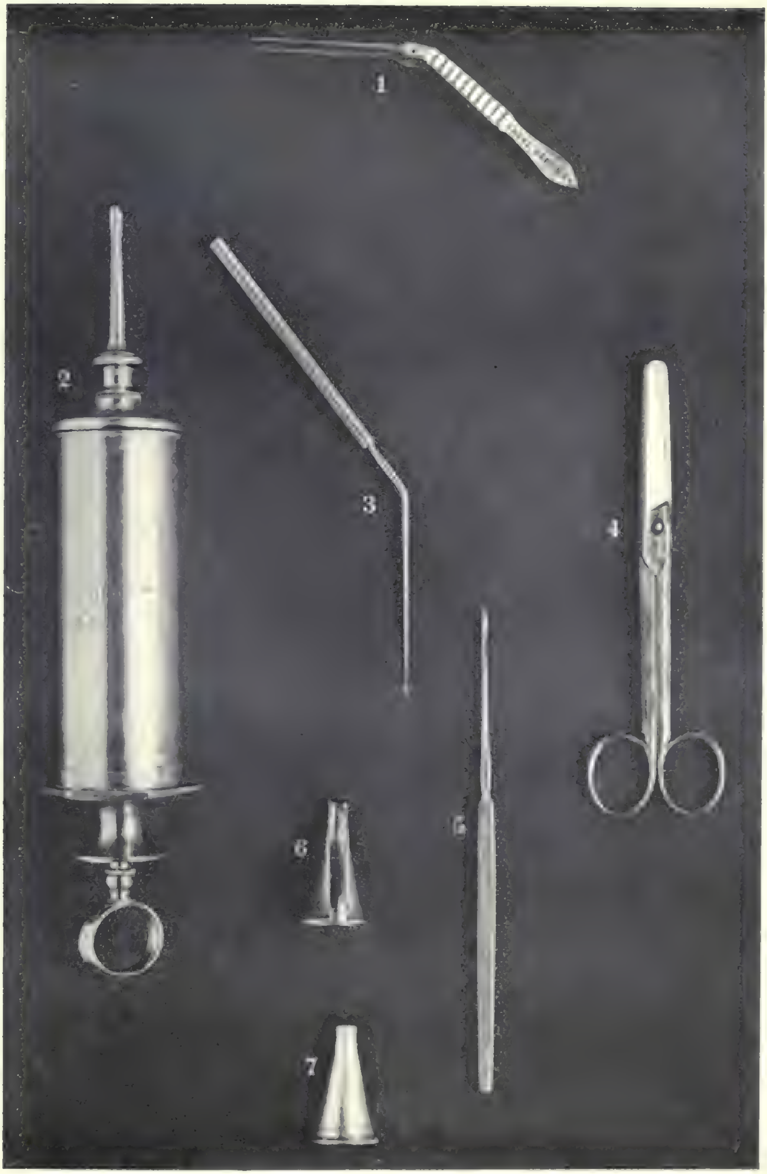
1. Marked bulging of the membrane.
2. Uncontrollable pain, with evidence of an acute infection of the tympanum.
3. Grave toxæmia.
4. Mastoid tenderness, whenever there is no certainty of suppurative mastoiditis.
5. Continued pain and bulging, with profuse ropy mucopurulent discharge.
6. Continued bulging due to subacute non-perforative catarrh.

General Preparation of the Patient.—Myringotomy is often performed under a local anæsthetic, or, in children, without anæsthesia. The pain is only momentary. Where the patient is nervous or a general anæsthetic is on other grounds desirable, gas, or gas and oxygen, is the simplest and best. The patient should not have recently taken food, but otherwise no general preparation is required. For local anæsthesia, Hechinger's solution produces a sufficient degree of insensibility. Its composition is:

INSTRUMENTS FOR MYRINGOTOMY.

1. Aural forceps.
2. Syringe.
3. Angular spear-headed myringotome.
4. Scissors.
5. Straight myringotome.
6. Operating speculum.
7. Aural speculum, ordinary pattern.

Plate III.



INSTRUMENTS FOR MYRINGOTOMY.

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Cocain. hydrochlor.	2 parts.
Acid. carbol. liq.	1 part.
Menthol	2 parts.
Rectified spirit	20 parts.

Local Preparation.—The meatus must be thoroughly cleaned and dried. Any discharge present should be removed by syringing with an antiseptic lotion, 1 in 4,000 biniodide of mercury being very suitable. The meatus is then mopped out with cotton-wool on aural forceps, and a speculum introduced. Through this the membrane is inspected, and any sodden epithelium is wiped away. A pledget of sterile cotton-wool is then carried down to the membrane.

Surgeon's Outfit:

Head-lamp.
Angular spear-headed myringotome.
Aural forceps.
Aural specula.
Operating speculum.
Syringe.

Lotion—1 in 4,000 biniodide of mercury.
Swabs formed of sterile cotton-wool pulled into small flakes, and narrow (¼ inch) fourfold gauze plugging for drying out and packing the meatus.
A gauze and wool dressing and bandage.
Apron.
Sterilized towel.

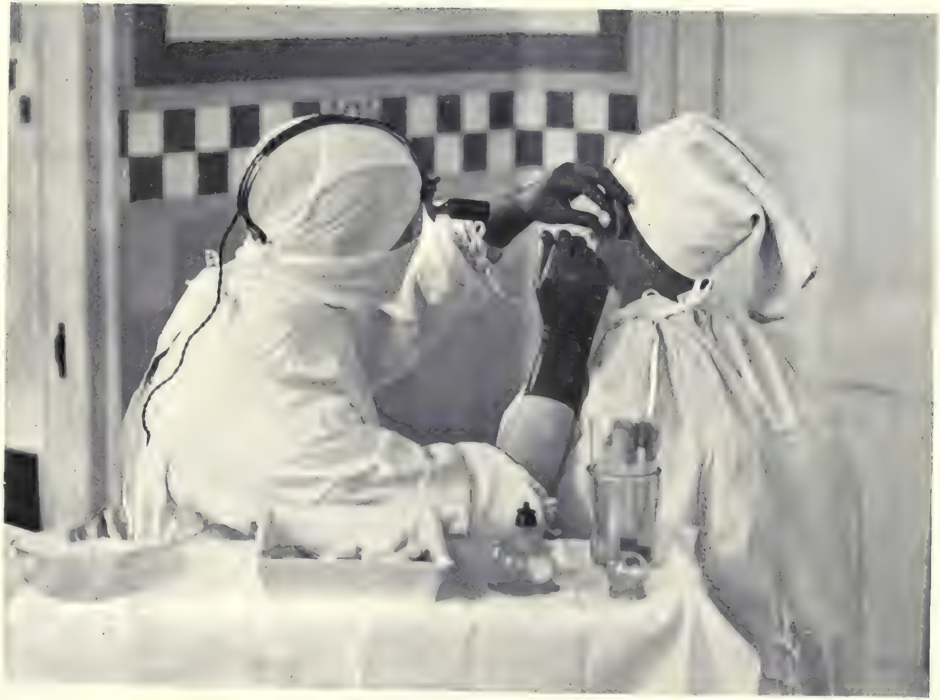
Culture-tubes (one agar-agar, one broth).
Platinum wire loop for inoculating the tubes.
Spirit-lamp.
Dissecting forceps.
Two lotion-bowls.
Small kidney-bowl.

Operative Tactics.—Unless a general anæsthetic is administered, the patient is seated in front of the surgeon, with the affected ear towards him. Under these circumstances it is convenient to use the frontal mirror. The nurse stands on a level with the patient, to the surgeon's left, and steadies the head.

If the operation is performed under a general anæsthetic, the patient must be in the recumbent position. It is convenient for all meatal operations that the table should be rather higher than the ordinary operating-table, so that the surgeon need not crouch on his stool to get a view, nor need the patient's head be too much twisted to the opposite side. The surgeon sits on a stool, the height of which can be altered to suit his convenience. A head-lamp giving a good illumination will be found more suitable than a frontal mirror. The assistant stands at the patient's head, and the anæsthetist opposite the surgeon. At the surgeon's right hand is a table for his instruments, conveniently of two shelves, on the lower of which stands the syringe in a bowl of lotion. It is the assistant's duty to turn the patient's head as the surgeon may require, and to hold the kidney-bowl while the ear is syringed.

Anæsthetic.—For local anæsthesia the patient's head is tilted to the opposite side, and the meatus is filled with Hechinger's solution. About seven minutes are required to anæsthetize the meatus and membrane. Where a general anæsthetic is required gas and oxygen is almost ideal; its action is rapid, and the patient's recovery is immediate. There is seldom any vomiting or other bad effects. If carefully given, there is no cyanosis to alter the appearances of the membrane, while there is ample time for the performance of the operation and for the introduction of a plug of gauze along the meatus before the patient's recovery.

Technique of the Operation.—The speculum, which should be as large as the meatus will comfortably admit, is introduced, and the light adjusted. When the surgeon has satisfied himself with the illumination, he proceeds to identify the position of the boundaries of the membrane and of the



OPERATIVE TACTICS FOR MINOR OPERATIONS THROUGH THE MEATUS WITHOUT A GENERAL ANÆSTHETIC.

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handle of the malleus. The knife is now taken between the forefinger and thumb, so that if the handle is horizontal the point looks upwards. It is steadied against the side of the last joint of the second finger. If gas is to be given, its administration should only now be begun. To make the incision the knife is passed along the meatus, and the point entered near the lower margin of the membrane and carried upwards, parallel with and behind the handle of the malleus when this is visible, until its edge is felt to touch the margin of the meatus above.* It is then withdrawn without touching the meatal wall. Cultures are best made directly from the blade by dipping it into the broth-tube. If cultures on solid media are also desired, the sterilized wire loop is introduced through the speculum and passed into the tympanum. As a rule, there is sufficient bleeding to make this of doubtful value. An alternative method is to rub the loop over the blade immediately it is withdrawn, and inoculate the agar tube from this. As the infection in acute otitis is almost always a pure one, the use of a fluid medium does not cause any inconvenience. The meatus is now dried out with wool, and a strip of gauze is carried down to the membrane. A small gauze and wool dressing is fixed over the ear with one or two turns of bandage.

After-Treatment.—If no perforation existed before the operation, the discharge will at first be thin and serous, and is readily absorbed by the gauze plugging. This should be removed in from six to twelve hours, after being well syringed. The removal of the deepest portion is apt to cause pain through adhesion to the edges of the incision. The meatus should be well syringed, dried, and a fresh strip of gauze introduced. The ear is again covered with a wool pad and a bandage is applied. If the discharge is scanty and the patient's temperature is raised, it is a good plan to apply a hot fomentation instead of the dry dressing. If the discharge is profuse, the dressing and syringing should be repeated every four hours. The membrane should be inspected at least each day.

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* If the handle of the malleus cannot be identified, the incision should be carried through the most bulging part of the membrane. In practice an incision so made will lie behind the handle of the malleus. In some cases it is possible to recognize a bulging of Shrapnell's membrane distinct from that of the tympanic membrane proper. Under these circumstances incision of the lower bulge will be found sufficient.

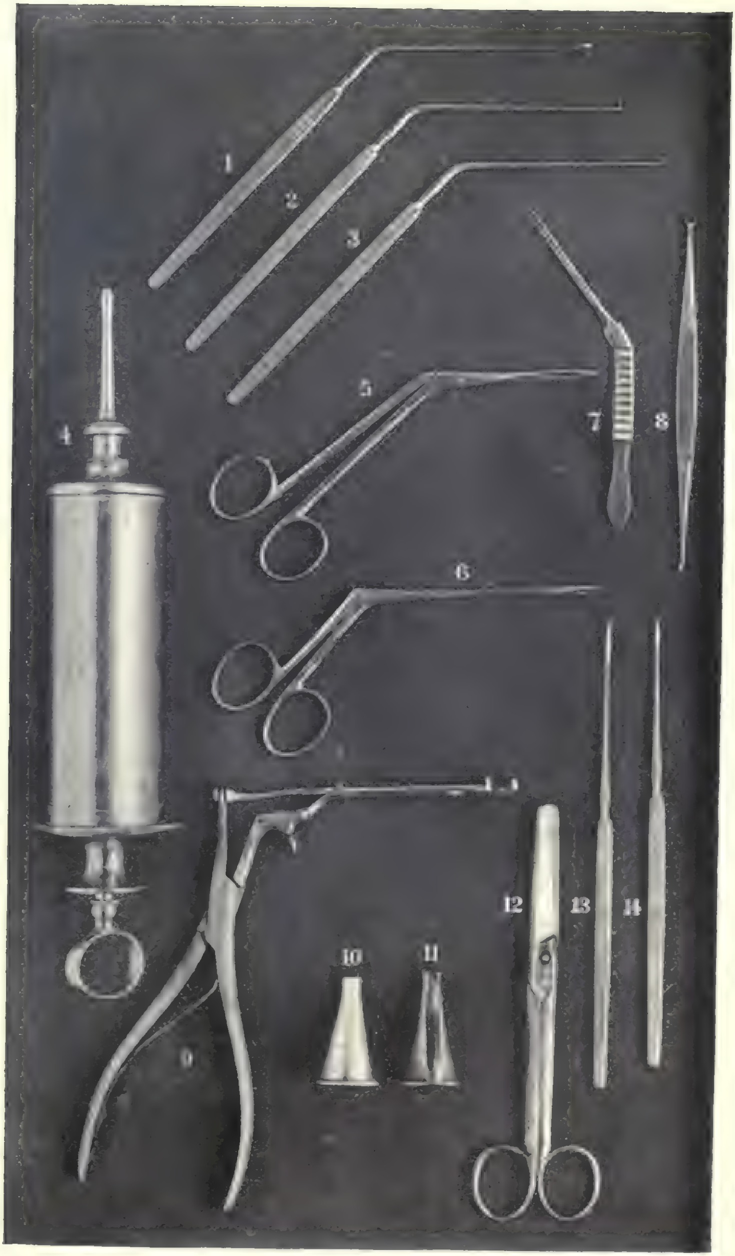
Results.—If the inflammation is confined to the tympanum and attic, there is almost immediate relief from pain, and, as a rule, a rapid fall of temperature. The membrane gradually resumes its natural attitude and colour. With the cessation of the discharge the incision, which has often already become much smaller, quickly closes, and the site of the wound, as a rule, becomes invisible. No bad effects on hearing are traceable to the incision.

As, however, a patient who has had a severe attack of otitis media may be left with permanently impaired hearing, and will be inclined to attribute this to the incision, if one has been made, it should be clearly put before him that there is in any case risk that the hearing may not be completely recovered; but that the incision, so far from adding to this, minimizes the danger, which increases with every hour during which the membrane is stretched and the inflammation unrelieved.

INSTRUMENTS FOR OSSICULECTOMY AND ATTIC RESECTION.

1.
2. Lake's loop curettes.
3.
4. Syringe.
5. Hartmann's forceps for removal of the malleus.
6. Crocodile forceps for removal of the malleus.
7. Aural forceps.
8. Double-ended spoon curette.
9. Faraci's forceps for the removal of the outer attic wall.
10. Aural speculum, ordinary pattern.
11. Operating speculum.
12. Scissors.
13. Straight blunt-pointed myringotome.
14. Straight sharp-pointed myringotome.

Plate V.



INSTRUMENTS FOR OSSICULECTOMY AND ATTIC RESECTION.

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CHAPTER IV

OSSICULECTOMY—ATTIC RESECTION

Definition.—The removal of the remains of the membrane and the malleus and incus, and the cutting away of the outer attic wall. In the operation extended in this way a combination of ossiculectomy with attic resection is employed. A much higher proportion of complete successes is obtained than by the old operation of ossiculectomy.

Indications.—In chronic suppurative otitis media resisting ordinary non-operative treatment:

1. Where it is of importance that the discharge should be stopped, while the patient cannot give the time from his occupations which is required by the radical operation; or where the patient has a strong objection to any cutting operation; and where there is no definite contra-indication.

2. Where there is very extensive loss of membrane, with isolation of the handle of the malleus or with loss of the handle, and especially where the incudo-stapedial connection is visibly destroyed.

3. Where there is persistent formation of granulations in the attic or on the edge of the outer attic wall.

4. Where there is evidence of accumulation of desquamated epithelium in the attic.

5. Where chronic suppuration of the antrum is suspected, the operation being done in these cases simply to allow of

more free access to the antrum for irrigation, and not as a primarily curative measure.*

6. In cases of exhausted suppuration in which there is severe tinnitus, and the handle of the malleus is bound down to the promontory by scar tissue.

Contra-indications.—1. Cases of simple attic perforation, with continued discharge and virtually intact hearing, except after the most persevering trial of other measures.

2. Where the meatus is small and contracted. (See Radical Operation.)

3. Where there is a history of past attacks of mastoiditis. (See Radical Operation.)

4. The occurrence of vertigo. (See Radical Operation.)

General Preparation of the Patient.—A general anæsthetic will always be required. The patient should have taken an aperient the previous night. No food should be given later than four hours before the time fixed for the operation, when a little beef-tea may be taken. An enema should be administered one hour before the operation, and the patient should pass water immediately before getting on the table.

Local Preparation.—Half an hour before the operation the ear should be thoroughly syringed out and dried. A cotton-wool plug soaked in the anæsthetic solution, or in cocaine-adrenalin mixture, is then pushed down the meatus into contact with the tympanic structures. This minimizes bleeding during the operation, and so makes its performance easier.

Surgeon's Outfit:

Syringe.
Aural specula.
Aural forceps.

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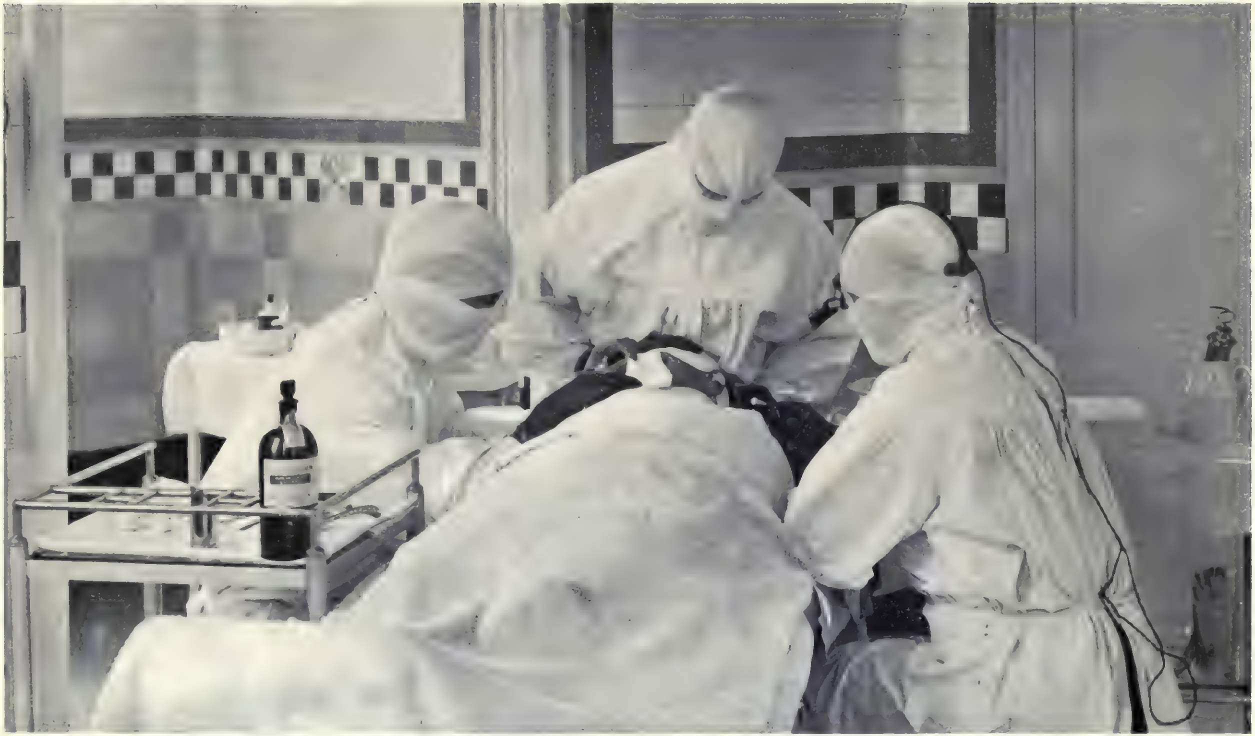
* If the Eustachian tube remains open, the tympanum is liable to re-infection from the pharynx; if, in addition, there is a tendency to repeated naso-pharyngeal catarrhs, as when adenoids are present, a continued muco-purulent discharge is the rule. Such cases will often give trouble even after the radical operation.

Plate VI.



OPERATIVE TACTICS FOR AN INTRAMEATAL OPERATION UNDER A GENERAL ANÆSTHETIC.

Operating speculum.
Straight myringotomes, sharp- and blunt-pointed.
Hartmann's forceps for removal of the malleus.
Lake's loop-curettes.
Right and left incus-hooks.
Faraci's forceps for the removal of the outer attic wall.
Double-ended spoon-curette.
Wool-carrying probes.

Head-lamp, or head-mirror.
Swabs formed of sterile cotton-wool pulled into small flakes, and narrow ($\frac{1}{4}$ inch) fourfold gauze plugging, for drying out and packing the meatus.
A gauze and wool dressing, and bandage.
Apron.
Three sterilized towels.
Two lotion-bowls.
One kidney-bowl.
Biniodide of mercury lotion (1 in 4,000).

Operative Tactics.—The patient lies in a supine position near the side of the table, with the head inclined somewhat to the opposite side. The surgeon is seated opposite the patient's head. His assistant stands at the head of the table. The anæsthetist takes his place opposite the surgeon. On the surgeon's right hand is a table for his instruments. A sterilized towel is spread over the patient's chest, and another is placed beneath the head; a third is wrapped round the head, passing below the occiput and round the forehead, and is secured by a safety-pin above the ear.

Anæsthetic.—The most suitable anæsthetic for this operation is chloroform. Ether is troublesome on account of the congestion which it produces, the greatest difficulty in the operation being the masking of the field by hæmorrhage. In children the A.C.E. mixture is quite suitable.

Technique of the Operation. — When the patient is anæsthetized, the cotton-wool plug is removed from the meatus, and any discharge which may have accumulated is syringed out and the meatus dried. The speculum is introduced and the fundus illuminated. The anatomical structures visible are identified. With the sharp-pointed myringotome the lower posterior margin of the membrane is cut through along its attachment to the tympanic ring. The upper anterior half of the membrane is now treated in the same fashion. In this way there is the minimum of trouble from the covering of the line of incision by blood. The knife is now carried across the notch of Rivini, cutting through the membrana flaccida, and passing over the neck of the malleus.

The Hartmann's forceps is now introduced through the speculum, and the neck of the malleus is firmly grasped. The correct grip is of the greatest importance, for if the handle is gripped it is certain to fracture when the attempt is made to extract the ossicle, and the body of the bone will be left behind. In the extraction of the malleus three distinct movements are employed: it is first rotated, so that the head is carried forwards and dislocated from the incus; the bone is next carried downwards into the tympanum; finally, it is brought out through the meatus. If any attempt is made to extract the bone without first bringing it down out of the attic, one of two things happens — either the malleus is fractured, or the forceps is pulled off and the bone remains *in situ*.

The operator has now a choice of two methods: he may either proceed to the removal of the incus or to that of the outer attic wall. The first is the classical method; it dates from the time when attic resection was not combined with ossiculectomy. The second method undoubtedly makes the removal of the incus a more easy and certain procedure. Its disadvantage is the possibility of dislocating the incus backwards into the antrum, where it may become impacted, and be in itself a sufficient cause of continued discharge. To remove the incus the oval loop-curette, with the loop turned upwards, is introduced into the tympanum, and the loop is carried up into the attic in the space rendered vacant by the removal of the malleus. It is then passed backwards and rotated downwards and backwards, so that the loop falls over the body of the incus. The rotation is continued, so that the loop passes finally downwards and forwards, carrying the incus with it into the tympanic cavity. Occasionally the incus becomes engaged in the loop, and is extracted in this way from the tympanum. More commonly it is necessary to remove it by syringing. The removal of the outer attic wall is effected by Faraci's forceps. This is best employed without a speculum, the operator relying on his sense of touch for guidance. The male blade is passed behind the anterior part of the attic wall, the handles depressed towards the patient's shoulder, and the female blade pushed home. The form of the female blade is such that several bites may be taken before there is any choking by débris. Successive portions of bone should be removed, the forceps being carried methodically backwards until the whole of the removable part has been cut away. In favourable cases not merely the attic wall, but also much of the outer wall of the aditus may be removed, so that the antrum may be directly entered from the meatus. As the forceps is carried backwards the handles must be brought forwards over the angle of the patient's jaw. In operating on the left side it is better to use the left hand to manipulate the forceps. Finally, the roof and hypotympanic recess are curetted. The cavity is now well syringed out with biniodide lotion, dried, inspected through the speculum, and lightly plugged with gauze. The gauze and wool dressing is placed over the ear, and the bandage adjusted. The gauze plug may have its end soaked in 10 per cent. solution of cocaine hydrochloride before its introduction. This minimizes the somewhat severe after-pain.

After-Treatment.—Pain is often a prominent feature in the first few hours, and is much more marked than after the complete operation. This is no doubt in part due to the relative shortness of the anæsthetic, from which the patient recovers with only a short subsequent period of analgesia. In part it is due to the laceration of the cuticle of the meatus by the forceps. The skin of the meatus is acutely sensitive. Pain will often require the administration of a small dose of morphia ($\frac{1}{4}$ grain) hypodermically. On the next day the dressing and gauze are removed, and the meatus is syringed out with biniodide lotion. On inspection at this time the result often appears most discouraging. There is a good deal of swelling of the edge of the meatal wall, which obscures the fundus, and makes it impossible to see how far the removal of the attic wall has been successful. Unless there is much tearing of the skin edge, so that a tag has been formed, there is no need to replace the plugging. From this time the case is treated on the ordinary lines adopted for chronic suppuration. It should be well syringed at least night and morning. It is advisable, though not necessary, that the patient be kept in bed for the first twenty-four hours, and remain in the house during the first three days. An aperient should be given on the second night. The patient may return to his ordinary occupations on the fourth day.

Results.—In suitable cases the results are strikingly good. The swelling quickly clears up, and the meatus resumes its normal appearances. There is an early diminution of discharge, and in from three to five weeks it completely ceases. In less favourable cases the discharge is diminished, though not completely arrested. The inner tympanic wall may become completely covered by squamous epithelium, and converted into a dry, shining surface, or may remain as a mucous-membrane covered area. In the latter case hearing is often particularly good, but there is the disadvantage that naso-pharyngeal catarrh is liable to cause a renewal of a mucous or muco-purulent discharge. As after the Radical Operation, the determining factor seems to be the obliteration or continued patency of the Eustachian orifice. The attempt may be made at the time of the operation to bring about its closure by the application of pure carbolic acid on a fine cotton-wool probe, which is pushed down the ostium tympanicum tubæ.

Where the indications given have been adhered to, the hearing may be distinctly improved by the operation. No improvement in hearing can be hoped for, when, before operation, there was much loss of bone-conduction, or such complete deafness to air-conduction that the patient was without useful hearing. In such cases the operation may none the less be indicated on surgical grounds. Cases in which the ossicles are found to have been the site of definite disease and show areas of erosion, or have granulations sprouting from them, are among the most favourable. There is good hope that in these the whole of the infected tissues may have been removed. Cases of cholesteatoma are only cured if the condition is restricted to the attic. Where there is chronic suppuration in the mastoid antrum there is little hope of more than a diminution of the discharge, and lessened risk through the provision of better drainage.

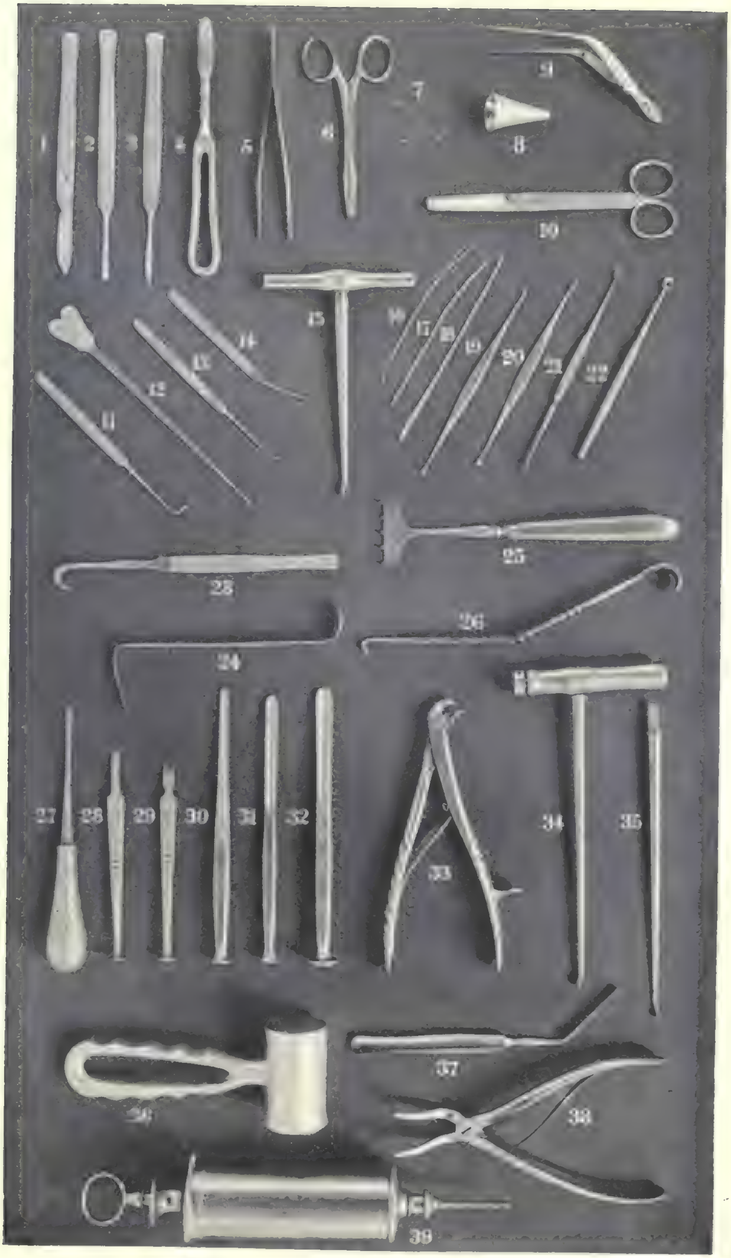
Misfortunes.—(*a*) *Injury to the facial nerve* may be inflicted either by the pressing in of the forceps against the inner tympanic wall or by indiscreet use of the curette. Such an injury may produce a severe facial palsy, which is likely to declare itself early. An inflammatory neuritis may occur, as after any interference with a chronic suppurating tympanum. It appears later, and as a rule progresses more slowly, increasing for two days or more.

(*b*) *Dislocation of the stapes* may take place, with danger of consequent labyrinthitis. It is a rare accident, and there should be no more risk of it than in the radical operation. As after any interference in a chronic suppurating cavity, there is always the possibility of opening paths of absorption by the removal of protective granulations, and cases operated on should not be left unseen for more than twenty-four hours at a time during the first few days. Among hospital outpatients the appearance of any untoward symptom should be the signal for prompt admission.

INSTRUMENTS FOR SCHWARTZE'S OPERATION.

1. Scalpel.
2. Blunt-pointed tenotome.
3. Sharp-pointed tenotome.
4. Periosteal elevator.
5. Dissecting forceps.
6. Pressure forceps.
7. Curved Hagedorn needles.
8. Aural speculum.
9. Aural forceps.
10. Scissors.
11. Angular steel probe.
12. Director.
13. Angular steel probe.
14. Straight steel probe mounted at an angle with the handle.
15. Cross-handled bone-cutting curette.
16. }
17. } Silver probes.
18. }
19. }
20. } Spoon curettes, various shapes and sizes.
21. }
22. }
23. Two-pronged retractor.
24. Retractor for the external auditory meatus, required for the modified operation with intrameatal drainage.
25. Rake-shaped retractor for the mastoid wound.
26. Retractor for insertion through the external meatus in the operation with meatal drainage (Heath's).
27. Small round-nosed chisel.
28. } Flat chisels.
29. }
30. }
31. } Gouges.
32. }
33. Horsley's bone-nibbling forceps.
34. } Hand burrs.
35. }
36. Hammer.
37. Dura mater elevator.
38. Jansen's bone-nibbling forceps.
39. Syringe.

Plate VII.



INSTRUMENTS FOR SCHWARTZE'S OPERATION.

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CHAPTER V

SCHWARTZE'S OPERATION (*Syn.* THE LIMITED MASTOID OPERATION; SIMPLE MASTOIDECTOMY)

Definition.—Schwartze's operation consists in opening the mastoid antrum and accessory cells through a post-aural incision, without disturbing the aditus, attic, or tympanum, or interfering with the tympanic membrane or auditory ossicles.

Indications.—The application of this operation is restricted to acute or recent cases of infective otitis media. The mastoid process is opened with the object of letting out pus and of removing infected tissue, with, as a collateral result, a great increase in effective drainage of the tympanum. The operation may also form a preliminary part of the radical tympano-mastoid operation, and of the intracranial operations for diseases of otitic origin.

1. **The limited mastoid operation is indicated in every case of acute infective otitis media in which the mastoid region becomes swollen, tender, and œdematous.** The formation of an inflammatory swelling in this region denotes extension of the infection from the tympanum, through the bone of the mastoid, to the periosteum covering it. Generally the infiltration leads to obliteration of the post-auricular groove, and to protrusion of the pinna outwards. Less commonly the superficial mastoid swelling forms over the posterior part of the base of the process, without causing displacement of the auricle or

obliteration of the post-auricular groove. In other cases the swelling travels directly upwards into the temporal fossa, and not infrequently spreads forwards above the zygoma towards the orbit. Sooner or later the swelling presents the usual features of an abscess. If the abscess is merely incised and the disease in the bone allowed to run its course, a chronic mastoid fistula will almost certainly be established, and the patient continues to be exposed to the attendant risks of some further, and possibly fatal, complication.

2. **In the course of acute infective otitis media, when expectant treatment, combined with incision of the tympanic membrane, has failed to influence the progress of the disease.**

(*a*) If the **fever** continues for five days after the first appearance of the discharge in the meatus, the decision to open the mastoid should be made. (If the patient is first seen on the fourth or fifth day, the surgeon may await during twenty-four hours the result of freely enlarging an existing perforation in the tympanic membrane before deciding to open the bone. Should fever still continue, even apart from other untoward signs, the antrum and cells should then be explored without any further delay.)

(*b*) In all cases in which there is deep-seated **pain,** or increasing mastoid tenderness, in spite of free discharge of pus from the tympanum (even when fever does not constitute a prominent feature of the illness), the opening of the mastoid should be undertaken. In many cases of this class there is no fever whatever.

(*c*) In cases presenting the appearance of **grave general illness** an operation should be performed. Much pain may not be complained of, and tenderness, when present, may be elicited only by firm pressure over a small area ; the temperature may not be raised much above normal, and even the pulse-rate may resist an increase for some days. Having regard to the risk of septicæmia in such cases, an immediate operation is advisable, as giving the best chance of arresting the septic process while this is yet possible.

(*d*) When **rigors** or **convulsions** occur, the mastoid should be at once explored.

In the presence of any of the following conditions, even without evidence of localized suppuration in the mastoid itself, the operation becomes urgent:

(*e*) **Continued** or **paroxysmal headache** (see also Indications for Operation for Extradural Abscess, etc.).

(*f*) **Vomiting**, especially when associated with headache or giddiness.

(*g*) **Nystagmus** (for further remarks concerning which, see Introductory Chapter).

(*h*) **Rapid or abnormally slow pulse-rate**—*e.g.*, over 120 or below 60—especially in conjunction with headache or unconsciousness.

(*i*) **Retraction of the head**, or stiffness of the suboccipital muscles.

(*k*) **Drowsiness**, unconsciousness, or coma.

(*l*) High or increasing **leucocytosis**—*e.g.*, 20,000 per cubic millimetre.

(*m*) Abnormal constituents in the **cerebro-spinal fluid** (see Lumbar Puncture).

3. **After a recent attack of acute otitis media**, when profuse discharge continues as the chief feature of the disease, a free opening into the mastoid cells should be made.

4. **After a recent attack of acute otitis media**, when profuse escape of pus alternates with symptoms of retention (*e.g.*, pain in the ear or occasional sudden rises of temperature), the mastoid antrum and cells should be opened and drained without interfering with the tympanum.

5. If symptoms of mastoiditis arise, **when an attack of acute otitis media has subsided**, even though discharge from the ear has ceased, Schwartze's operation should be performed.

6. The same operation is called for in a class of case occasionally encountered and characterized by **mastoiditis consecutive to non-perforative otitis media.**

The patient may have earache and deafness, followed by pain, tenderness, and swelling over the mastoid, without the appearance of any discharge in the meatus. Only in the early phases is the tympanic membrane red, swollen, possibly bulging. The congestion in the tympanum may rapidly subside without the formation of any perforation. In a few days even the expert may be unable to detect otoscopic appearances significant of acute middle-ear disease, although the pain, swelling, tenderness, and œdema are of the usual character present in mastoiditis.

In the same class may occur cases in which the infection is deep-seated in the bone without external signs.*

General Preparation of the Patient.—If the patient is seriously ill, no undue delay should be allowed after the operation has been decided upon. No milk or solids should be given within six hours of the operation. In ordinary cases an aperient is given the previous night. The bowels should be emptied by means of a soap-and-water enema one hour before the operation.

Local Preparation of the Patient.—The skin is to be shaved over an area extending about 1½ inches around the pinna, and washed with soap and water. Owing to the sensitiveness of the part, this preparation, which must be thorough, is usually deferred until the patient is anæsthetized. The field of operation is then rubbed over with ether, and afterwards with spirit lotion (biniodide of mercury, with equal parts of rectified spirit and water, strength 1 in 500). The latter is washed off with aqueous solution of biniodide (1 in 2,000).

Surgeon's Outfit:

Scalpel.
Dissecting forceps, three pairs.
Pressure forceps, six pairs.
Scissors, two pairs.

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* It is also worth while in certain cases of *chronic* attic suppuration, in which the hearing power is good, to make trial of the effect of antral drainage by Schwartze's operation.

Periosteal elevator.
Retractors.
Gouges, various sizes.
Flat chisels, various sizes.
Metal hammer.
Angular and straight probes, various sizes.
Aural speculum.
Aural forceps.
Cross-handled bone-cutting curette.
Double-spoon curettes, various patterns.
Jansen's bone-nibbling forceps.
Horsley's bone-nibbling forceps.
Curved needles.
Silkworm gut, catgut, and silk.
Electric head-lamp, or forehead mirror.

Aprons.
Rubber gloves, three pairs.
Sterilized towels, four.
Syringe.
Sterilized absorbent wool.
Swabs, two dozen.
Cyanide gauze, fourfold strips, ¾ inch wide.
Trays, two, for instruments and ligatures.
Bowls for hand lotion, wool swabs, and soiled dressings.
Irrigator.
Kidney-shaped bowl.
Macintosh sheet.
Methylated spirit for knives.
Biniodide of mercury (1 in 2,000 aqueous).
Biniodide of mercury (1 in 500 methylated spirit).
Ether soap.
Razor.
Platinum loop.
Culture-tubes.
Spirit-lamp.

Operative Tactics.—The operating-table should be narrow, strong, and of an adjustable height. The patient lies flat on the back on a folded blanket; a light pillow or folded bath-towel is placed beneath the head and shoulders, and a small sand-bag or thick towel against the side of the head, to keep it in the desired position. The field of operation must be protected by sterilized towels, the hair being completely covered by a towel fastened around the forehead and occiput (see illustration). The surgeon stands on the side to be operated upon, with the anæsthetist opposite. The chief assistant stands at the head of the table and retracts the wound, keeps it free from blood, and sees that the head is in the position required by the surgeon. The instruments are arranged in trays on a table beside the operator, and the swabs and bowls on another table beside the chief assistant.

Anæsthetic.—Chloroform is preferred, owing to the troublesome oozing of blood which occurs with ether. The operator is greatly handicapped if the chloroformist permits the slightest degree of cyanosis from partial obstruction to respiration by lips, tongue, or jaw, for this immediately causes oozing, even with the administration of chloroform.

Technique of the Operation.—It is convenient to describe the operative procedure in the following stages:

Stage 1. Skin incision, opening the superficial mastoid abscess when present, and exposure of the mastoid surface.

Stage 2. Opening of the accessory cells and antrum.

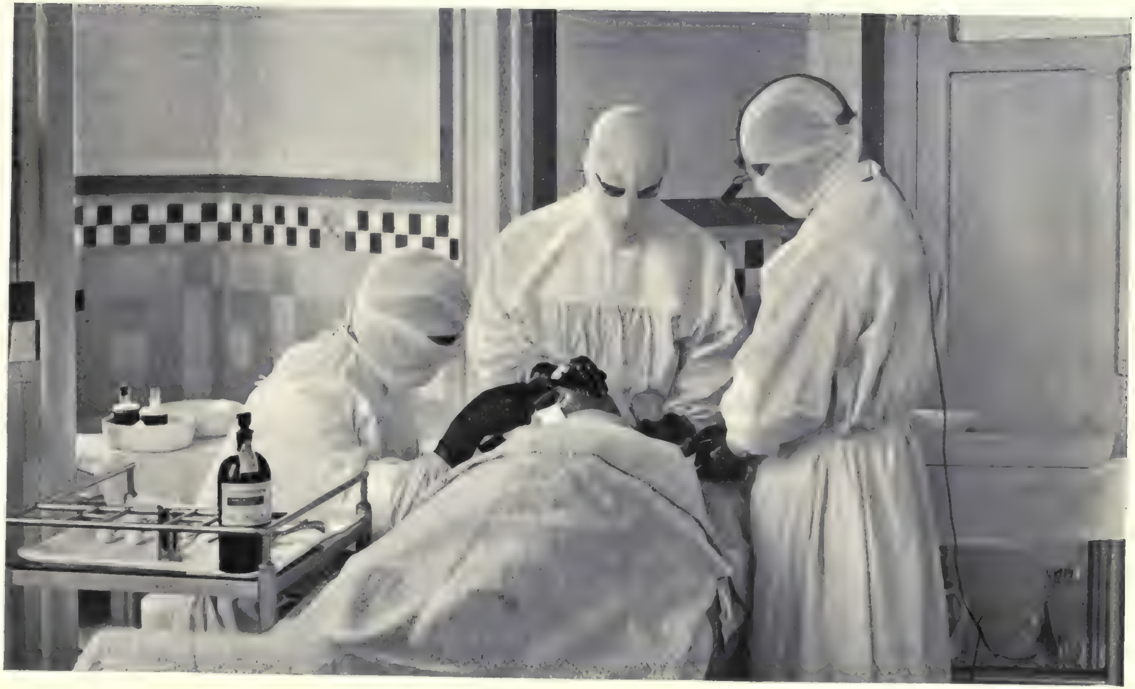
Stage 3. Examination of the walls of the operation cavity.

Stage 4. Closure and drainage.

STAGE 1. THE SKIN INCISION.—The skin incision should be curved, and more or less concentric with the normal position of the post-auricular groove.

It commences at the extreme upper attachment of the pinna, and passes in a curved direction backwards and downwards over the mastoid, terminating at the level of the floor of the external auditory meatus. When an abscess has formed, the incision must be made so as to lay the abscess

Plate VIII.



OPERATIVE TACTICS FOR OPERATIONS ON THE MASTOID.

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cavity open. When there is no swelling, the incision should pass about $\frac{1}{3}$ inch from the post-auricular groove; when much swelling is present, the incision should be more curved, and should be carried to the apex of the mastoid.

When there is a fistula, the incision should pass through the fistula.

The skin, superficial fascia, and retrahens aurem are divided, care being taken not to open the temporal fascia unless this is involved in suppuration. A few vessels may require control with pressure forceps.

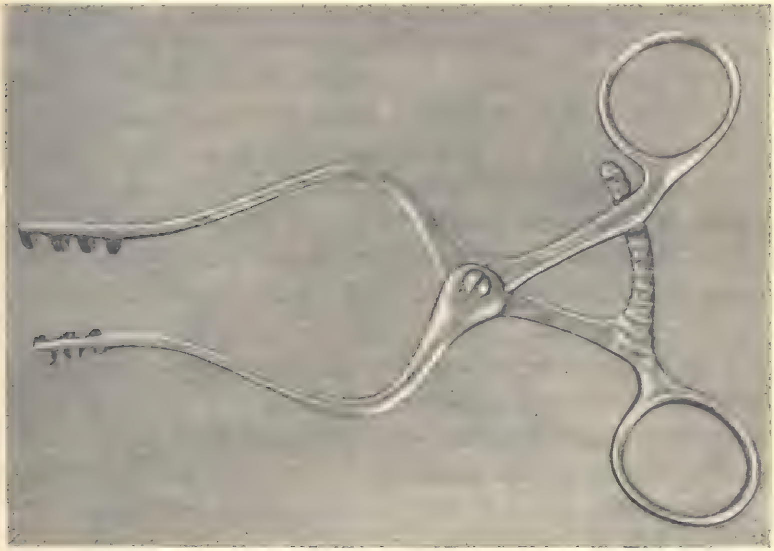


FIG. I.—AUTOMATIC RETRACTOR FOR USE IN OPERATIONS ON THE MASTOID.

The subcutaneous tissue should be dissected forwards off the temporal fascia and periosteum, so that the pinna can be drawn downwards and forwards with a sharp-pronged retractor. The periosteum is then divided with the knife along the suprameatal crest, and down the line of the lower half of the skin incision. The periosteal flap thus formed can be stripped forwards until the posterior border of the osseous meatus is displayed. Care is necessary not to open the membranous meatus at this stage. When the tissues are much swollen or an abscess has formed, no attempt is made to separate the integuments from the periosteum, everything being divided down to the bone. The abscess cavity should be irrigated if there is much pus, and the granulations should be scraped out with a large curette. Firm pressure is then applied with a pad of gauze until the oozing subsides.

Before proceeding to open the bone, its surface should be carefully scrutinized. It may be perfectly normal and non-vascular, but if there is any periostitis and the superficial tissues are infiltrated, the bone is hyperæmic and porous, and may be soft and yielding. When a subperiosteal abscess has formed, a hole large enough to admit the end of a probe can often be discovered, and pus may be seen exuding—sometimes in a pulsating stream. The softened area may be found on the postero-superior wall of the bony meatus, instead of on the external surface of the mastoid. In some cases the outer layer of bone is found to be necrosed, and delimited from the living bone.

STAGE 2. OPENING THE ANTRUM AND MASTOID CELLS. —As regards the position of the antrum, two principal facts must be remembered: (1) that the greater part of the antrum lies above and posterior to the postero-superior wall of the osseous meatus; and (2) that the outer wall of the antrum lies in a plane external to the posterior attachment of the tympanic membrane.

As regards the accessory cells, they may be large or small, widespread or closely packed, or no cells may be present, according to anatomical variety or as a consequence of pathological changes.

There are no external landmarks by which to foretell with certainty the anatomical arrangement of cells in the mastoid in any particular case. The only constancy is found in infants, in whom the antrum is relatively large and superficial, and no accessory cells are present.

(*a*) **When there is no periosteal abscess,** the outer cortex is cut away with the gouge, which is laid upon the mastoid at an oblique angle, and made to cut upwards and forwards into the bone in the direction of the antrum. Only comparatively thin shavings are taken at first, and the excavation is deepened by cutting away successive layers around the opening in the upper and anterior part of the mastoid. Gradually a cone-shaped cavity is formed, the apex being directed inwards parallel with the postero-superior meatal wall. As the cavity deepens the opening in the bone is widened downwards and backwards by channelling the cortex radially upwards and forwards, to give a freer exposure. The sudden appearance of pus may be due to the opening of the antrum, or of cells external to the antrum, or of an extradural abscess, and the cavity should be explored cautiously with a rectangular seeker. The walls of cells, if present, must be cut away with the cross-handled curette or gouge until an entrance is effected into the antrum itself. In exploring the antrum care must be taken to avoid passing the seeker into the aditus and displacing the incus. Overhanging bone above, below, and behind must be cut away, so that the antral cavity is laid widely open, and its walls made to slope continuously and smoothly with the walls of the outer cavity. A constant outlook must be maintained for any exposed dura mater, which should be immediately recognized.

(*b*) When, on exposing the outer surface of the bone of the mastoid, **a fistula, superficial caries, or necrosis** is discovered, the surrounding cortex is removed with the gouge, and the path of infection followed into the bone. Sometimes the fistula leads straight into the posterior cranial fossa, an event which can be generally ascertained by observing the direction taken by a probe. The utmost caution must be exercised in using the probe for exploring a fistula in this situation, for if it leads into a perisinous abscess cavity, the instrument may easily penetrate the sinus.

The removal of the first layer of the cortex may cause pus to escape; in other cases the pus is only found at a greater depth.

Sometimes the bone is soft, and the cells are full of inflamed and swollen mucosa, with little or no pus; sometimes it is diffusely cellular, with pus filling the cells. The opening in the bone must now be enlarged with the gouge, and the cavity thoroughly scraped out with the cross-handled curette until all softened and infected tissue has been removed. Some experience is needed to recognize the normal cancellous texture of bone, which is less yielding than bone containing inflamed mucosa and granulations.

The antrum is now sought for and opened, and the operation continued as in the typical procedure already described.

STAGE 3. EXAMINATION OF THE OPERATION CAVITY. — The cavity must be irrigated if there is much débris. Packing with absorbent wool or gauze will soon check the oozing. Diligent and careful search is now made for cells unopened, soft tracks, or fistulæ through the bone leading to an extradural abscess, or to dural fistulæ and associated conditions, brain abscess, or lateral sinus thrombosis. The possibility of a collection of pus in the digastric fossa or sheath of the sterno-mastoid (Bezold's mastoiditis) must also be considered, especially when there has been diffuse swelling and tenderness in the upper part of the neck. Bent and straight steel probes are used in making the examination of the walls of the cavity. To follow out all cells may necessitate enlarging the original wound with a short cross cut, or by prolonging the incision downwards. The position of the aditus should be made out, and granulations occluding its entrance should be removed with a curette, care being taken not to disturb the incus or injure its attachments. When the dura mater is found to be covered with granulations, the surrounding bone should be removed, so that the whole of the affected area of dura mater is exposed. Jansen's forceps are particularly useful for this purpose. A flat elevator is introduced between the bone and dura mater to separate them from each other, with the object of exploring the adjacent intracranial surfaces of the petrous for a collection of pus. Granulations on the dura mater should be gently curetted and the dura examined for a fistula leading to the brain or to the interior of the lateral sinus (*q.v.*).

STAGE 4. DRAINAGE AND CLOSURE OF THE WOUND.—The drainage of the cavity may be, according to circumstances, either (*a*) **post-aural** or (*b*) **intrameatal.**

As a rule, the former is to be preferred. Intrameatal drainage is suitable only when the accessory cells are not extensive, when pus is confined to the region of the antrum, and when there is no periostitis or swelling of the integuments.

(*a*) **Post-aural Drainage** should be invariably practised when there is much infiltration of the subcutaneous tissues, when a subperiosteal abscess is present, and when the bone is extensively diseased.

Unless the swelling is unusually great, the incision can be sutured with advantage. Fishing-gut sutures are inserted in such a way as to include a fair thickness of the integuments.

A rubber tube with side holes about the calibre of a No. 12 urethral catheter is inserted near the middle or lower end of the incision, where it is secured with a stitch. It is occasionally useful, if the bone cavity is unusually extensive, to employ two such tubes side by side, each being kept in position by a separate stitch through the posterior margin of the wound.

It is sometimes well to leave the middle sutures long, so that they can be tied and the edges of the wound drawn together, as the swelling subsides in the course of a few days.

When the cavity is spacious and in part bounded by softened dura mater, it is better to lightly fill it with gauze, so much of the wound being unsutured as will facilitate subsequent dressing. After a few days the wound is sutured; any cavity remaining is drained by rubber tube in place of gauze. Secondary suture of such wounds may be easily carried out under local anæsthesia.

(*b*) **Intrameatal Drainage.** — When it is decided to drain the cavity through an opening into the meatus, the posterior wall of the osseous meatus must be removed. After detaching the cartilaginous meatus posteriorly, the outer part of the bony wall is cut away with a gouge during the second stage of the operation (*q.v.*). Great care is necessary to avoid injury to the tympanic membrane or its attachment to the tympanic ring.

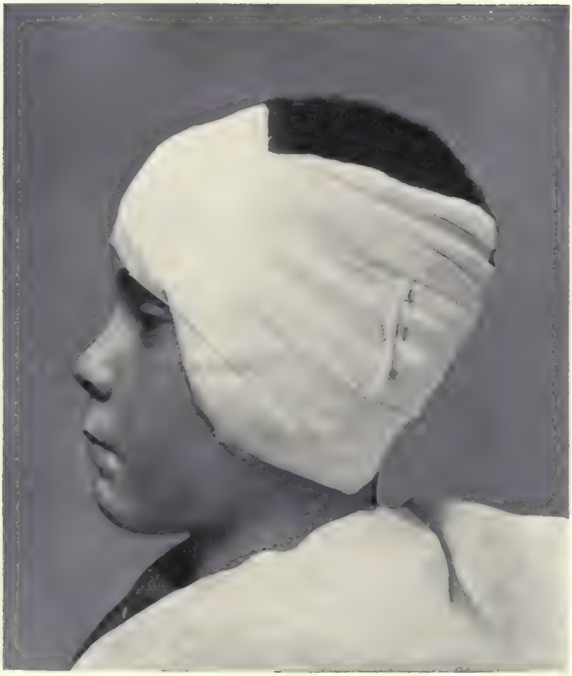
Retractors are removed and vessels ligatured. The meatus is then cleansed with wool on meatal forceps. The operator takes the pinna in thumb and forefinger of the left hand, and with a narrow sharp-pointed knife inserted into the meatus forms the concho-meatal flap by dividing its posterior wall along its junction with the floor of the meatus. The incision is then carried across the inferior margin of the junction of the meatus with the concha, is swept upwards through the concha about $\frac{1}{8}$ inch behind and concentric with the posterior and upper margins of the meatal orifice, and terminates above in the crus helicis.

The flap, consisting of the posterior meatal wall, and part of the concha is turned backwards and upwards. To make it thin and pliant the cartilage and thick fibrous tissue in the flap is removed by dissection, while the pinna is once more retracted forwards.

The posterior auricular artery is generally severed in cutting along the outer part of the meatal floor, and bleeds freely. It is seized with pressure forceps close to the cartilaginous floor and ligatured.

It may be necessary to cut away a strip from the outer margin of the flap to make it lie smoothly against the roof of the cavity. The wound is then lightly filled with a gauze strip, passed along the meatus down to the tympanic membrane, and upwards and backwards into the antral region, pressing the flap upwards. After being satisfied that the

Plate IX.



THE OCCIPITO-FRONTAL BANDAGE, APPLIED TO A CASE OF SCHWARTZE'S OPERATION.

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flap lies securely in position against the roof of the cavity, the operator closes the post-aural incision with a row of interrupted fishing-gut sutures.

Dressings.—Whichever method of drainage is adopted, by gauze or tube, intrameatal or post-aural, the outside gauze dressings are applied in the usual way. The first piece of gauze, which is cut out to the shape of the post-auricular groove, is laid upon the wound behind and close up to the attachment of the pinna. Two or three other pieces of gauze cover the pinna and surrounding parts, and over these a thick layer of absorbent wool is placed. The dressings are secured with an occipito-frontal roller bandage, care being taken not to include the opposite pinna in the bandage.

After-Treatment.—A nurse remains with the patient until the immediate effects of the anæsthetic have passed off, a towel and small bowl being at hand in case of vomiting. After a time water may be given to allay thirst, but no food, until nausea has completely ceased. The return to ordinary diet will be determined by the patient's temperature, appetite, and the state of the stomach.

Pain.—The relief which the operation gives to pain is usually so great that the patient experiences complete comfort and repose. When pain does continue, or returns after a day or so, it should be regarded as evidence of some unrelieved condition; thereupon the temperature, pulse, state of the tongue, and the condition of the patient must be considered, as a further operation may be necessary. The management of the case must thenceforward be conducted from this point of view (see Indications for Operation for Extradural Abscess, etc.).

FIRST DRESSING.—In all cases of acute mastoiditis the wound is dressed within twenty-four hours of the operation.

DRESSING OUTFIT:

Head-light.
Syringe.
Dressing forceps.

Aural forceps.
Probe.
Scissors.
Macintosh.
Sterilized towel.
Gauze packing (strips fourfold, ¼ inch wide and 2 feet long, in rolls).
Cyanide gauze dressing.
Sterilized absorbent wool.
Bandage.
Safety-pin.
Kidney-shaped bowl.
Bowl for soiled dressings.
 „ instruments.
 „ hand lotion.
Irrigator.
Biniodide lotion (1 in 2,000).
Hydrogen peroxide, "10 vols."
Hot fomentation if required.

The arrangements should be made for dressing the ear with as little disturbance to the patient as possible.

The surgeon's hands must be prepared as for an operation. A warm macintosh sheet is placed beneath the patient's head and shoulders, with the lower margin turned up a couple of inches, the pillow being removed.

The patient lies on the back, with the face turned towards the opposite shoulder. The field of operation is surrounded by a sterilized towel.

When everything is in readiness the bandage is cut, and the outer dressing turned down carefully; if this is adherent, it should be saturated with lotion until it can be easily detached: when dry and hard, freshly prepared hydrogen peroxide will permeate and soften the dressing most rapidly. Before withdrawing the gauze packing it must be well moistened. First one edge of the strip and then the other should be seized, and loosened by traction with strong forceps;

further difficulty may be overcome by axially twisting the gauze. If care is taken not to draw the packing over the cut margin of the meatus, the patient will be spared much pain.

(For additional remarks on the removal of gauze from mastoid cavities, see under After-Treatment, Operation for Lateral Sinus Thrombosis.)

As soon as the packing has been withdrawn the cavity should be irrigated. The fundus of the meatus should be carefully wiped and dried, and the cavity filled with gauze as before. (In those cases in which intrameatal drainage of the mastoid antrum has been adopted, attention is necessary to see that the flap is in place before the gauze is replaced.)

FOMENTATIONS.—If there is much swelling or tenderness, hot fomentations afford great relief. They should be renewed every two to four hours until the symptoms subside, when dry dressings may be resumed.

In those cases in which the wound has been left entirely or in greater part open, and the cavity treated by packing, a plastic operation may be required about the end of the second week to close the wound, and to correct the position of the pinna. The margins of the wound are separated by undercutting until sufficient relaxation of the tissues is obtained to allow the edges of the wound to be drawn together with interrupted sutures. No drainage will be necessary unless the cavity cannot be completely occluded, in which case a rubber tube may be inserted into the lower end of the wound.

Tube-drained cavities should be syringed freely at each dressing, but the tube need not be disturbed before the third day. It is then temporarily withdrawn, and replaced after being cleaned and boiled. After the fifth or sixth day, according to the rapidity with which granulations form, the tube can be slightly shortened. The shortening should not be hurried, and the tube should never be replaced by one of smaller calibre.

Throughout the after-treatment, whatever method of drainage has been adopted, the tympanum needs attention. Syringing the meatus free from discharge represents an important part of the dressing. By inflation an effort may be made to expel discharge from the tympanum into the antrum, or through a perforation into the meatus.

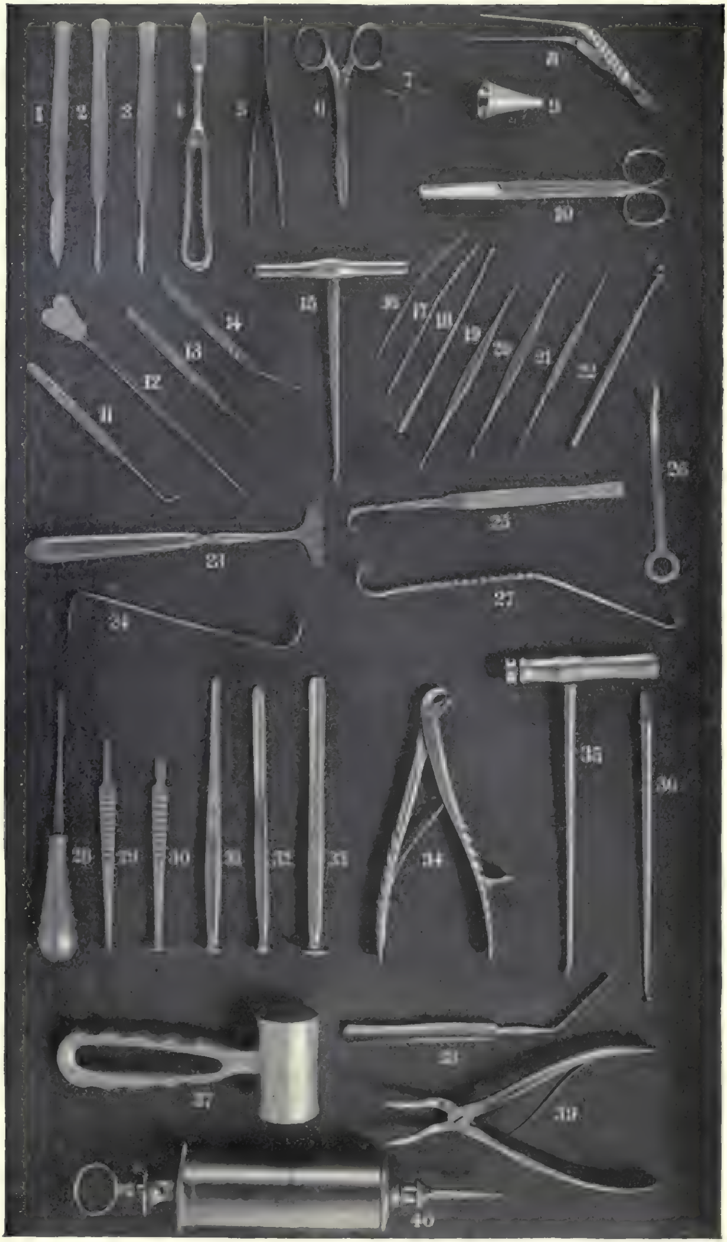
In cases suited to the operation the otorrhœa rapidly subsides, and the perforation, as a rule, heals. Cases in which discharge persists must be kept under observation, and special attention should be directed to the nasal cavities and the pharynx.

Hearing.—By this operation the tympanic structures are not interfered with, and under no circumstance can it prejudicially affect the recovery of hearing. On the other hand, by cutting short the disease, damage to hearing power is minimized, and early and complete return to the normal condition may be anticipated in the majority of cases.

INSTRUMENTS FOR THE RADICAL MASTOID OPERATION.

1. Scalpel.
2. Blunt-pointed tenotome.
3. Sharp-pointed tenotome.
4. Periosteal elevator.
5. Dissecting forceps.
6. Pressure forceps.
7. Curved Hagedorn needles.
8. Aural forceps.
9. Aural speculum.
10. Scissors.
11. Angular steel probe.
12. Probe-pointed director.
13. Angular steel probe.
14. Straight steel probe.
15. Cross-handled bone-cutting curette.
16.
17. Silver probes, various sizes.
18.
19.
20. Spoon-curettes, various sizes and forms.
21.
22.
23. Rake-shaped mastoid retractor.
24. Retractor for the meatal wall.
25. Small two-pronged retractor.
26. Stacke's guard.
27. Retractor for insertion through the external meatus.
28. Small round-end chisel.
29. Flat chisels.
30.
31.
32. Gouges.
33.
34. Horsley's bone-nibbling forceps.
35. Hand-burrs (Heath's).
36.
37. Hammer.
38. Dura mater elevator.
39. Jansen's bone-nibbling forceps.
40. Syringe.

Plate X.



INSTRUMENTS FOR THE RADICAL MASTOID OPERATION.

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CHAPTER VI

THE RADICAL OPERATION (*Syn.* THE COMPLETE POST-AURAL OPERATION; THE TYMPANO-MASTOID OPERATION)

Definition.—Essentially the radical operation is a combination of Schwartze's operation with that of ossiculectomy and attic resection.

It consists in exposing the antrum and accessory cells, when present, through the outer surface of the mastoid; in extending the cavity in the mastoid forwards by resecting the posterior meatal wall; and in laying freely open the cavity of the tympanum by removal of the membrane and the whole of the outer wall of the attic, with the remains of the malleus and incus.

Thus the antrum, tympanum, and external meatus are converted into one common cavity, accessible to inspection and treatment through a suitable opening.

Indications for the Radical Operation.—The indications for the radical operation may be such as to make it

1. Imperative;
2. Advisable; or
3. Elective.

1. Imperative Indications.—To this class belong certain symptoms giving evidence of conditions immediately dangerous to life.

In the course of chronic suppurative otitis media:

(*a*) Symptoms pointing to intracranial complications of middle-ear disease. See under Extradural Abscess, Lateral Sinus Thrombosis, Brain Abscess (Temporo-sphenoidal and Cerebellar), Labyrinthitis, Meningitis.

(*b*) Grave general toxæmia.

(*c*) Any of the following symptoms or conditions:

i. Persistent severe headache or pain in the ear, especially when accompanied by mastoid tenderness.

ii. Fever.

iii. Vertigo or spontaneous nystagmus of labyrinthine origin (see Appendix).

iv. Facial paralysis.

2. INDICATIONS OF ADVISABILITY. — **In the course of chronic suppurative otitis media**:

(*a*) When there is an external mastoid fistula.

(*b*) When polypi reappear after removal during the continuance of treatment.

(*c*) When granulations continue to grow in spite of repeated destruction by chromic acid.

(*d*) When there is a fistulous track leading from the meatus into the mastoid.

(*e*) When the meatus is abnormally narrow.

(*f*) When the presence of a cholesteatoma has been ascertained.

(*g*) When the disease is tuberculous, as shown by bacteriological examination.

3. ELECTIVE INDICATIONS.—To this class belong cases of middle-ear suppuration which do not fall under the preceding categories, but in which the chances of cure without operation are remote. Each case must be judged on its own merits; the surgeon will naturally be unwilling to urge the operation where hearing is well preserved.

(*a*) **In the course of chronic suppurative otitis media**:

i. When long-standing disease continues in spite of sustained non-operative treatment, especially when the ear is useless as an organ of hearing.

ii. When there is progressive loss of hearing.

iii. When there is a history of recurrent attacks of fever and mastoid tenderness.

iv. When the patient is the subject of anæmia, headaches, mental or physical depression, with loss of general health.

v. When the patient is an applicant for a life-assurance policy, or is a candidate for the public services.

(*b*) **As an alternative to Schwartze's operation,** in certain cases of acute mastoiditis, following recent diphtheritic or scarlatinal otitis, especially when there is evidence of extensive tympanic disease.

Contra-indications.—The radical operation is contra-indicated under the following circumstances, the limited mastoid operation taking its place (see Schwartze's Operation):

1. When acute otitis media is complicated by acute mastoiditis.

2. If intracranial complications or general infection arise after recent inflammation in the tympanum has subsided (see Extensions of Schwartze's Operation).

3. In cases of chronic otorrhœa, with attic perforation, possessing good hearing.

General Preparation of the Patient.—The patient must be prepared for general anæsthesia: an aperient should be given twenty-four hours before the operation, and an enema one hour before the operation. A little beef-tea, meat essence, or clear soup may be given three or four hours before, but on no account should milk or solid food be given at this time.

Local Preparation of the Patient.—The skin must be shaved over an area extending 1½ or 2 inches around the pinna; the surface is then thoroughly washed with soap and water. The field of operation is rubbed well with ether, and finally with spirit lotion (a solution of biniodide of mercury in equal parts of rectified spirit and water, strength 1 in 500).

This local preparation may be postponed until the patient is anæsthetized.

Surgeon's Outfit:

Scalpel.
Sharp- and blunt-pointed tenotomes.
Dissecting forceps, three pairs.
Pressure forceps, six pairs.
Scissors, two pairs.
Periosteal elevator.
Retractors.
Gouges—5, 8, and 15 millimetres broad.
Flat chisels—5 and 8 millimetres broad.
Small round-end chisel—3 millimetres broad.
Metal hammer.
Angular and straight steel probes.
Silver probes, various sizes.
Stacke's guard.
Aural speculum.
Aural forceps.
Double spoon-curettes.
Cross-handle cutting spoon-curette.
Hand-burrs.
Jansen's bone-nibbling forceps.
Horsley's bone-nibbling forceps.
Syringe.
Irrigator.
Curved needles.
Silkworm gut.
Catgut.
Silk (00. 0. 1.)
Electric head-lamp.

Aprons.
Rubber gloves for surgeon and all assistants.
Sterilized towels, four.
Absorbent wool.
Swabs, two dozen.
Rubber drainage-tubes.

Cyanide gauze, fourfold strips, ¾ inch wide.
Trays, two, for instruments and ligatures.
Bowls for hand lotion, syringing lotion, swabs; receiving bowl.
Kidney-shaped bowl.
Macintosh sheet.
Pure carbolic acid.
Lotion biniodide of mercury (1 in 2,000 water).
Lotion biniodide of mercury (1 in 500 spirit).
Methylated spirit.
Ether-soap.
Razor.

Operative Tactics. — The operating-table should be strong, narrow, and adjustable in height. A folded blanket is placed beneath the patient, with a light pillow or folded bath-towel under the head and shoulders. A small sand-bag or small folded towel may be used to steady the head in the desired position.

The field of operation is guarded by sterilized towels, the hair being covered by a towel fixed round the forehead and occiput (see illustration). The surgeon stands on the same side as that to be operated upon, and the anæsthetist opposite the surgeon; the chief assistant is at the head of the table: it is his duty to see that the wound is kept retracted and free from blood, and that the head is in the most suitable position for the purpose of the operator. The instruments are arranged in trays on a table by the side of the surgeon, and the swabs and wool in bowls on another table at the side of the chief assistant.

Anæsthetic.—In the radical operation, even more so than in the limited mastoid operation, chloroform is to be preferred to ether, owing to the troublesome oozing of blood which occurs with the latter. The operator is greatly handicapped if the anæsthetist is not specially watchful to prevent the slightest degree of obstructed breathing, which immediately produces free oozing of blood, even when chloroform is administered. In cases specially troublesome from bleeding, pure oxygen gas, or suprarenal extract, or cocaine, have been applied locally; but these are rarely necessary where chloroform is skilfully given.

Technique of the Operation.—It is convenient to consider and describe the operation in the following stages:

Stage 1. Skin incision and exposure of the mastoid surface.

Stage 2. Opening of the accessory cells and antrum, with removal of the posterior meatal wall.

Stage 3. Opening of the attic.

Stage 4. Removal of the ossicles and tympanic membrane.

Stage 5. Examination of the walls of the operation cavity.

Stage 6. Treatment of the Eustachian orifice.

Stage 7. Plastic operation.

Stage 8. Closure of the wound.

STAGE 1. SKIN INCISION AND EXPOSURE OF THE MASTOID SURFACE.—The skin incision should be curved, and more or less concentric with the post-auricular groove (Fig. 2). It commences at the extreme upper attachment of the pinna, and passes in a curved direction backwards and downwards over the mastoid, about $\frac{1}{3}$ inch from the post-auricular groove, terminating at the level of the floor of the external auditory meatus. In this incision skin, superficial fascia, and the retrahens aurem muscle are divided. Care should be taken not to incise the temporal fascia.

In cases in which a fistulous track opens through the skin on the mastoid surface, the incision should pass through the fistula. When the integuments are much swollen, a longer incision will be required.

In infants, before the development of the mastoid process, the lower part of the wound should not extend to the cervical fascia below the meatus, on account of the superficial position of the facial nerve, where it emerges from the cranium.

The subcutaneous tissue should be dissected forwards, so as to separate the attachments of the auricle from the temporal fascia in the upper part, and from the periosteum in the lower part, of the wound. This dissection will enable the operator to recognize the upper and posterior margins of the osseous meatus with the finger.

The pinna is now held downwards and forwards, and the blade of the knife is entered at right angles to the mastoid surface, immediately above the meatus, and is carried horizontally backwards, dividing the periosteum along the suprameatal crest as far as the line of the skin incision, and from this point downwards to the lower limit of the wound.

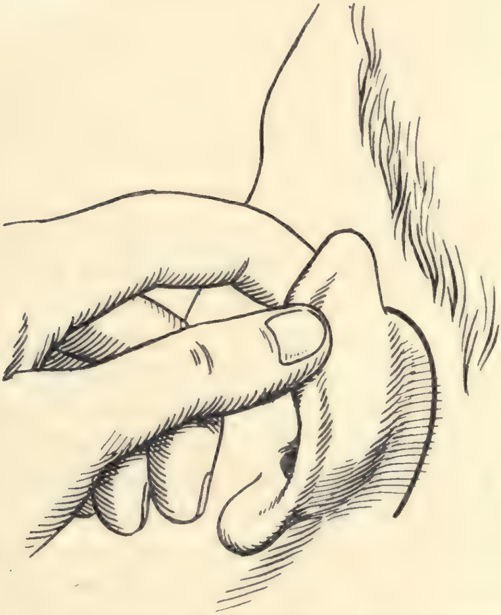


FIG. 2.—THE INCISION FOR THE RADICAL MASTOID OPERATION.

Care is necessary, lest the membranous meatus be injured, for this would interfere with the subsequent plastic operation.

The periosteum thus incised can now be stripped forwards until the osseous meatus is displayed, the delicate lining of which is carefully detached from the posterior wall and roof with a narrow elevator. By means of a sharp-pronged retractor firmly inserted into the anterior lip of the wound, the auricle is retracted downwards and forwards, and taken charge of by the second assistant. When the services of a second assistant are unobtainable, the automatic retractor will be found useful.

STAGE 2. OPENING THE ANTRUM AND ACCESSORY MASTOID CELLS, WITH RESECTION OF THE POSTERIOR MEATAL WALL.—In exposing the antrum, two principal facts must be borne in mind:

(*a*) That the main cavity of the antrum lies above, and posterior to, the postero-superior wall of the osseous meatus.

(*b*) That the outer antral wall occupies a position external to the postero-superior margin of the tympanic ring.

The only true guide to the antrum is the postero-superior wall of the osseous meatus. Measurements of the thickness of the outer wall of the antrum at various ages are valueless as indicating the depth at which the antrum is placed, for the thickness of the mastoid cortex cannot be gauged before the antrum is opened. The relation of the antrum to the tympanum and to the postero-superior wall of the osseous meatus can always be ascertained by means of the rectangular probe passed from the tympanum upwards and backwards through the aditus into the antral cavity.

The exposure of the antrum sometimes appears simple to the inexperienced onlooker, and he may be tempted to regard the operation as being free from special difficulties. In reality even the apparently simple cases are full of pitfalls. Competency to operate can only be acquired by a practical knowledge of the anatomical variations encountered, and by habitual familiarity with the use of propelled instruments.

No external landmarks exist by which to distinguish the disposition of cells in the mastoid in any particular case;

nor can we tell whether the exposure of the antrum will be easily accomplished or beset with the greatest difficulties.

There are three main anatomical features which may impede the exposure of the antrum:

(*a*) The absence of accessory mastoid cells external to and below the antrum. Except in infants, the outer cortex may be extremely dense, and as much as ¾ inch in thickness.

(*b*) The forward position of the lateral sinus, which is often within ¼ inch of, and occasionally reaches closer up to, the posterior meatal wall.

(*c*) Bulging downwards of the floor of the middle cranial fossa external to the antrum and below the level of the suprameatal crest.

It is not uncommon to meet with all three obstacles in the same subject.

The outer cortex of the mastoid is cut away with a gouge and heavy metal mallet. The gouge is made to cut obliquely upwards and forwards in the direction of the postero-superior wall of the meatus and antrum. The excavation is deepened in its upper and anterior part by the removal of successive layers of bone, so forming a cone-shaped cavity, the apex of which is directed along the postero-superior wall of the meatus, which is also cut away. The resection of the posterior meatal wall constitutes an important difference between the Radical Operation and the Limited Mastoid Operation (see also remarks upon Intrameatal Drainage, Schwartze). As the cavity is deepened, the opening is widened downwards and backwards, the original form of the cavity being maintained. When an entrance has been effected into the antrum, the overhanging walls of the cavity must be cut away to lay the antrum widely open.

A constant outlook must be maintained for the lateral sinus posteriorly, and superiorly for the dura mater of the middle cranial fossa, any exposure of which should be at once recognized.

Accessory cells must be sought for in the cut surface of the bone with the steel probe. The bone between adjacent cells must be removed, and all cells thoroughly opened up into the common operation cavity. To follow out all cells it may be necessary to enlarge the original wound by a short cross incision, or by prolonging it downwards.

STAGE 3. OPENING THE ADITUS AND ATTIC.—After the antrum has been opened and overhanging bone removed, Stacke's guard is passed forwards from the antrum through the aditus. This guard protects the external semicircular canal and the tympanic part of the facial aqueduct. The outer attic wall is removed as a wedge-shaped piece of bone by two cuts with the chisel. The first cut is made horizontally inwards through the outer wall of the aditus and tympanic margin ("the bridge"); the second cut is made obliquely inwards, upwards, and forwards through the remaining upper part of the posterior wall of the meatus. The bridge of bone external to the guard, thus divided above and below, is removed as a small wedge-shaped mass. After its removal, the aditus, attic, and epitympanic cells, when present, should be fully opened by cutting away all overhanging bone in the deepest part of the roof of the operation cavity. Additional room can be gained by removing the small spur formed by the posterior end of the tympanic ring. This must be done with extreme caution with a narrow, flat chisel. Its removal is necessary to expose the inner tympanic wall for full inspection.

Throughout this stage of the operation loose fragments of bone are liable to accumulate in the cavity; they should be removed by small spoon-curettes. Oozing is checked by pressure with pledgets of wool or strips of gauze.

STAGE 4. REMOVAL OF THE REMAINS OF THE TYMPANIC MEMBRANE, MALLEUS, AND INCUS.—In cases of long-standing suppuration it is often impossible to detect any remains of the incus. The malleus, with its greater blood-supply, resists destruction longer. The remains of the tympanic membrane, with any portions of these ossicles, granulations, and cholesteatomatous masses when present, are removed from the tympanum with a small curette. In so doing care must be taken to avoid dislodging the stapes or injuring the facial nerve. The operator must also bear in mind the proximity of the jugular vault below and posteriorly, and of the internal carotid artery anteriorly. The cavity must be carefully inspected to see that all fragments are removed.

STAGE 5. THE EXAMINATION OF THE WALLS OF THE OPERATION CAVITY.—The walls of the operation cavity must now be carefully and systematically examined ; to obtain a satisfactory view the cavity must be well illuminated and kept free from blood. Soft bone in the walls of the antrum should be scraped away with small sharp curettes.

A diligent search with the steel probe should be made for incompletely opened accessory cells. If any are found they must be fully opened up ; no overhanging bone must be left in any part of the cavity. The state of the roof of the cavity must be investigated. The dura mater and the lateral sinus must be examined if exposed. The external arcuate eminence must be identified ; its surface may be eroded, or the lumen of the external semicircular canal may be open. Any softened cancellous bone above the external semicircular canal should be removed. The facial aqueduct must next be examined for any defect in its wall. The promontory of the cochlea can be identified as a white area standing out in contrast to the surrounding parts of the inner wall of the tympanum. In special cases an attempt should be made to identify the pelvis ovalis between the promontory and the facial aqueduct, and to determine the integrity of the foot-plate of the stapes with a fine flexible probe, in the use of which the utmost care and light-handedness must be exercised.

Throughout this part of the examination the patient's face should be constantly watched by an assistant, who should immediately warn the operator if any twitch occur at the angle of the eye or mouth.

Special attention should be directed to granulations in the sinus tympanicus and hypotympanic recess, which may be reached by small suitably curved curettes.

It is sometimes necessary to remove remains of the upper part of the facial spur and the posterior part of the tympanic ring to bring the floor and posterior part of the tympanic cavity into view. The removal of these parts should be conducted with the utmost caution, owing to the danger of injury to the facial nerve, the bone being cut away in thin layers.

STAGE 6. ATTENTION TO THE EUSTACHIAN TUBE.—The occlusion of the tympanic end of the Eustachian tube is essential for ultimate complete healing of the cavity. All granulations at the entrance to the tube must be thoroughly curetted away, so that the anterior margin of the annulus tympanicus and the anterior part of the promontory of the cochlea can be plainly seen. After removing the granulations, pure carbolic acid may be applied on a small wool swab with toothed aural forceps to the tympanic end of the tube.

STAGE 7. PLASTIC OPERATION.—For the proper management and ultimate success of the after-treatment of the wound this is a very important procedure. We have ourselves tried numerous described methods of drainage, and have modified and devised others, but none has given more satisfactory results than the following, which is a modification of Mr. Ballance's original method. Its object is to enlarge the meatus, and make use of the epithelium on its posterior wall.

After retractors have been removed and vessels ligatured, and the meatus cleared of blood and bone débris, the operator takes the pinna between the left thumb and forefinger, and with a sharp narrow-bladed knife passed into the meatus cuts along the whole length of the floor of the canal. The incision is carried across the inferior margin of the junction of the meatus with the concha, and then swept upwards through the concha about $\frac{1}{8}$ inch behind and concentric with the posterior and upper margins of the meatal outlet, and terminates on the lower margin of the crus helicis above the meatus. Exactly how far it is desirable to carry the incision into the concha depends upon the shape and size of the cavity which has been made. The flap so formed can now be hinged backwards and upwards against the roof of the mastoid cavity. The cartilage and fibrous tissue in the flap is removed by dissection while the pinna is held forwards. The thin skin flap will lie smoothly against the roof of the cavity; no sutures are required to keep it in this position. Care must be taken with the inner and the outer margins of the flap that neither becomes curled. It is often advisable to clip away the internal free angle of the flap with scissors; the outer margin may require to be trimmed to make it lie smoothly. The posterior auricular artery is generally cut as it runs close to the floor of the cartilaginous meatus. It is seized with pressure forceps and ligatured.

STAGE 8. DRAINAGE OF THE CAVITY AND CLOSURE OF THE WOUND.—The original wound is closed with three or more silkworm gut or catgut sutures, inserted separately. The cavity is then packed through the enlarged meatus with a fourfold gauze strip ¾ inch wide. The packing is passed first along the floor of the meatus and forwards into the tympanum, then upwards into the attic, then upwards and backwards, completely filling the antrum, mastoid cavity, and meatus. Should the mastoid cavity extend below the level of the floor of the meatus, a rubber tube should be placed in its most dependent part through the lower end of the post-auricular incision.

Dressings.—Sterilized gauze is now applied, either dry or wrung out of biniodide of mercury solution (1 in 4,000). The advantage of the moist dressing lies in the facility with which it can be removed. The first piece of gauze should be cut to the curve of the post-auricular groove, and is laid upon the wound behind the pinna. Other pieces of gauze cover the pinna and an area beyond it, extending at least 2 inches in all directions. The gauze is covered with absorbent wool, which should be thickest behind and below. The dressings are secured with an occipito-frontal roller bandage.

After-Treatment—GENERAL.—After the operation a nurse remains in attendance upon the patient until the effects of the anæsthetic have passed off. A towel and a small bowl should be in readiness in case of vomiting. After a time water may be given. Except in infants, whose feeding should not be interrupted, very little nourishment is needed during the first twenty-four hours. As a rule, the patient can take a light diet on the second day. When the appetite returns ordinary food may be given.

The patient may be allowed to sit up on the fifth day after the operation, for a few hours at a time, and if all goes well he may be allowed out on the eighth day in fine weather.

TREATMENT OF SPECIAL SYMPTOMS, ETC.—**Pain** after the radical mastoid operation is less severe than might be anticipated. We might go so far as to say that its degree depends more upon the temperament of the patient than upon anything else. When necessary to secure a first night's repose, 5 to 10 minims of the tincture of opium may be given. A hypodermic injection of morphia should only be given if nausea prevents the patient from taking the opiate by the mouth.

Nausea and Vomiting.—When the patient has been properly prepared for general anæsthesia, and when chloroform has been skilfully administered, nausea and vomiting are not prolonged, and do not generally require special treatment. Occasionally vomiting is troublesome. Free draughts of water should be given to wash out the stomach; to the water may be added a small quantity of magnesia or sodium bicarbonate. An effort should be made to get the bowels thoroughly open by small repeated doses of calomel. If the patient can be induced to sleep soundly, the vomiting does not often recur. Vomiting continuing to the third day may be due to infection of the labyrinth, and this possibility should always be carefully considered. A constant watch must be kept for the development of nystagmus, with which acute and recent infection of the labyrinth is associated (see also Examination of Labyrinth, Appendix). Vomiting may also be due to an unrelieved intracranial lesion.

Insomnia.—During the first thirty-six hours sleeplessness may be due to pain, discomfort, unusual surroundings, temperament. For persistent insomnia a cause should always be sought. Discretion must be exercised in the use of drugs for its relief.

LOCAL AFTER-TREATMENT.—As a rule, the dressings need not be changed until the third day. The outer dressing is then removed. Unless the patient is in discomfort or pain, or unless the dressings have an offensive smell, the packing need not be removed until the fourth day.

The post-aural wound nearly always heals rapidly and completely by first intention. Suppuration is rare. If suppuration takes place, and the edges of the incision become swollen and red, tension should be relieved by the removal of one or more stitches, and hot fomentations should be applied every three hours. Dry dressings should be resumed as soon as possible.

DRESSING OUTFIT.—The following will be required:

Head-lamp or reflecting mirror.
Syringe.
Irrigator.
One pair dressing forceps.
One pair aural forceps.
Probe.
Scissors.
Five small round bowls.
Hand lotion (spirit and biniodide of mercury—1 in 1,000).
Peroxide of hydrogen (10 volumes per cent.).
Biniodide of mercury lotion (1 in 4,000).
Kidney-shaped bowl.

Macintosh.
Sterilized towel.
Sterilized gauze and wool dressing.
Bandage.
Safety-pin.

The surgeon's hands must be disinfected as for an operation. A warm macintosh should be placed beneath the patient's head and shoulders, with the lower margin turned up a couple of inches. The patient lies on the back, with the face turned towards the opposite side. The region to be dressed is surrounded with a sterilized towel. The outer dressings having been loosened and removed, the gauze next the wound is gently detached. If this is adherent, it should be moistened until quite loose, when it can be gently peeled off the skin. The gauze packing is now thoroughly saturated with lotion, and the edge of the strip of gauze gripped within the meatus with strong forceps and carefully withdrawn by traction. If the gauze is dry and adherent, it may be loosened after saturation by axial rotation, instead of by direct traction. Care should be taken to avoid dragging the plugging over the edge of the meatal opening, which is very sensitive.

In young children it may sometimes be desirable to administer a light general anæsthetic for the first dressing. After the gauze has been withdrawn the cavity is irrigated and dried. Attention should be directed to the meatal flap, which should lie smoothly and evenly; any displacement should be rectified at the first dressing. For irrigation the lotion of biniodide of mercury (1 in 4,000) is used at a temperature of 100° F. When used at a higher or lower temperature, the patient may become giddy (see Introduction, Nystagmus).

After the cavity has been dried, it is packed again with fourfold gauze strip, $\frac{1}{2}$ or $\frac{3}{4}$ inch wide. The end of the strip must be introduced into the tympanum with aural forceps, then into the attic and into the mastoid region, until the whole cavity is filled. A fresh outside dressing is applied as before.

At each dressing the same care and attention to detail are to be observed. The healing process must be watched, and the formation of granulations controlled when excessive by pressure of the packing, or by chromic acid. Granulations first appear on the cut margins of the membranous meatus, later over the surface of cancellous bone, and last on the compact bone. It is not uncommon for the lower part of the posterior meatal wall to remain uncovered by granulations for two weeks or longer. The epithelium appears to spread over the surface of the granulations from the margin of the skin flap above, and from the cut edges of the meatal floor and concha below and externally. Particular attention must be directed to the tympanic cavity throughout the management of the case. If the packing of the tympanum is neglected or imperfectly conducted, irregular granulations may form, causing delayed healing. When the packing is carefully attended to, and the gauze always introduced so that it fills the tympanum, healing of this part of the cavity often anticipates that of the mastoid cavity.

At the beginning of the third week very little outside dressing will be required, and by its end none will be necessary. Packing must be continued with daily dressing until the cavity is completely healed. This will take at least four weeks in the most favourable cases, and generally longer. The majority are completely dry and covered with epithelium in about six or seven weeks. When healing is deferred beyond this time, some cause for delay may usually be discovered. If, after thorough examination, no explanation is found, a complete change of air and surroundings will generally be followed by healing. Local treatment must never be interrupted until healing is complete. It is well to try the effect of introducing gauze packing moistened with a saturated solution of picric acid or with a 1 per cent. solution of zinc sulphate.

Skin-Grafting.—We have not found it necessary to resort to skin-grafting to insure complete cicatrization of the cavity formed by the radical operation. Though we have made use of the procedure in isolated cases, our experience of it has not been extensive. Those who may be interested in the details of its technique are referred to the full account by Mr. Ballance in his original paper.

Misfortunes.—In the hands of surgeons with an extensive experience of operations on the mastoid the risks of misadventures during the radical mastoid operation are comparatively small.

INJURY TO THE FACIAL NERVE. — The facial nerve is exposed to the risk of injury during the performance of the radical operation in three parts of its course:

1. In infants, at the stylo-mastoid foramen, where it may be severed if the skin incision is carried deeply into the neck below the level of the meatus.

2. In the descending part of the Fallopian aqueduct, where it may be lacerated or severed in resecting the postero-inferior part of the meatal wall near the tympanic ring.

3. In its tympanic part, where it may be lacerated or severed in removing "the bridge" to open the attic and aditus, in cutting away the facial "spur," and in curetting the tympanum in the region of the nerve.

Complete and permanent paralysis due to section of the facial nerve must be regarded as nothing less than a disaster. It is irremediable. The deformity is not hidden by nerve anastomosis. (For other causes of facial paralysis, see Misfortunes arising after the Operation.)

INJURY TO THE LATERAL SINUS AND ITS TRIBUTARIES.—Hæmorrhage due to injury of the lateral sinus or its tributaries may be produced in several different ways. A sharp-cornered chisel should never be used for the removal of bone in the neighbourhood of the lateral sinus or dura mater. If used over the sinus, its sharp corner may easily penetrate the bone and cut into the vessel. The round-cornered gouge is much less likely to penetrate through the bone and vessel wall, but a tributary, as it enters the lateral sinus, may be severed with the gouge, or the sinus may be nipped with the gouge.

The sinus may be lacerated by a fragment of bone driven into it, or may be nipped and torn with bone-cutting forceps. The mastoid vein is cut or torn as it runs in its bony canal. The hæmorrhage may be very severe.

If the sinus is injured before it has been fully exposed, as, for instance, by penetration of the gouge, the hole in the bone must be plugged with gauze, and the wounded sinus fully exposed by removing the bone around the area of penetration. This must be done rapidly, and the bleeding should be meanwhile controlled by packing with gauze strips as the aperture in the bone is enlarged.

If the lateral sinus has been fully exposed before the injury occurs, the sudden great loss of blood must be arrested by the immediate application of pressure with the finger to the injured vessel. A fourfold gauze strip is then inserted in place of the finger, being introduced between the sinus and the bone so as to press the walls of the sinus against each other above and below the seat of injury.

Infrequent as the wounding of the lateral sinus may be, when it does occur the tremendous bleeding may be enough to unnerve a surgeon of fair operating experience. The bleeding must be instantly controlled, and the operation proceeded with. However disconcerting the incident, it does not justify the operator in abandoning the operation even temporarily. If the surgeon is not prepared to complete the radical operation, the patient is left in a worse state than he was before, and instead of the operation being a successful achievement, it becomes a dismal failure.

Injury to the External Semicircular Canal.—The eminence of the external semicircular canal may be opened accidentally with the gouge or large curette unless its position is known and recognized. When opened at some distance from the ampulla, no untoward symptoms may arise; when near the ampulla, temporary giddiness follows, and there is risk of infection of the vestibule, with subsequent meningitis (*q.v.*).

INJURY TO THE VESTIBULE.—The stapes may be dislocated and the vestibule opened unwittingly in curetting the tympanum, unless the fossa ovalis is deliberately avoided. Severe giddiness and complete deafness are certain to follow such an accident; infection of the vestibule is inevitable, and the risk of meningitis is considerable.

INJURY TO THE INTERNAL CAROTID ARTERY.—This is well within the realms of possibility, as the artery runs close to the entrance of the Eustachian tube, below and in front of the cochlea. A gauze strip should be introduced and strongly compressed, while preparations are made for ligaturing the artery high in the neck.

INJURY TO THE JUGULAR BULB.—Occasionally the jugular vault extends so high and its bony walls are so thin that they are readily penetrated by curettes. The jugular bulb may be covered only with mucosa or granulations, in the floor of the tympanum, and a sharp curette may readily enter the vessel, causing profuse bleeding.

FACIAL PARALYSIS.—It may not be out of place to further consider facial paralysis occurring after the radical operation, of which the following are the causes:

1. Contusion of the nerve, without laceration.
2. Compression of the nerve.
3. Inflammation.

Paralysis, which is immediate, complete, and permanent, is due to laceration.

1. When due to contusion the paralysis is immediate in onset, but may at first be incomplete. The condition is as a rule temporary.

2. When paralysis is brought on by compression, it becomes noticeable within the first twenty-four hours, and rapidly increases, but nearly always recovers if the packing is re-

moved at once. This form of paralysis is avoided by packing loosely where the facial nerve is known to be exposed.

3. When facial paralysis is due to inflammation, there is a delay of two to five days before the onset. It may be partial and short-lived; it sometimes becomes complete.

Other remote misadventures arising after the radical mastoid operation are produced by sepsis. Such are cellulitis, lymphadenitis, and lymphangitis; erysipelas; sinus thrombosis and septicæmia; sloughing of the lateral sinus, and hæmorrhage; suppuration in the sheath of the sternomastoid muscle.

CHAPTER VII

THE OPERATION FOR EXTRADURAL ABSCESS

(EXTENDED SCHWARTZE'S OR RADICAL OPERATION)

THIS operation is not to be regarded as an independent procedure, but is an extension, immediate or remote, of an operation on the mastoid. The surgeon is led to the opening of many extradural abscesses which have given no clue to their existence, if he follows to the end the softened bone wherever he discovers it; while if the diagnosis of extradural abscess has been made, the best and most direct route to its thorough opening and drainage is through the limits of the mastoid cavity. The opening of an extradural abscess as an independent operation, while the primary focus of infection in the mastoid is left untouched, is a procedure which has no place in modern surgery.

Indications.—The symptoms of an extradural abscess are often entirely latent, or are so fused with those of the affection in the mastoid that they cannot be separated from them. When existent, they are rather those of inflammation of the dura mater than of a collection of pus. It may be said that a confident diagnosis of extradural abscess can rarely be made until an operation on the mastoid has failed to give relief, or to account for the symptoms. These will be:

1. Continued pain and headache.

2. Deep-seated pain on percussion over the suspected area, or tenderness on pressure, especially when this is developed behind or above the mastoid area.

3. Elevation of temperature, often only slightly marked.

4. Delayed improvement after a radical operation has been performed. This should always give rise to a suspicion that some deeper cause for anxiety has remained undiscovered; an extradural abscess is the commonest.

5. Rarely an extradural abscess of large size will give rise to symptoms simulating a cerebral abscess, with marked optic neuritis, or of sinus thrombosis with repeated rigors.

General Preparation—Local Preparation.—These will in no particular differ from those for the radical operation, which really forms a part of the present procedure.

Surgeon's Outfit.—As for the radical operation.

Operative Tactics.—As for the radical operation.

Anæsthetic.—In all cases chloroform is preferable to any other anæsthetic. It is particularly so when there is any possibility of a brain abscess.

Technique of the Operation:

STAGE I. PERFORMANCE OF THE RADICAL OPERATION (see Chapter VI.).—Where this has already been done, the wound is to be reopened, and all discharge, clot, and granulations removed by curetting. The cavity is now syringed out and dried.

STAGE 2. INSPECTION OF THE WALLS OF THE CAVITY for any area of caries or necrosis, which, if found, will probably overlie the abscess.

STAGE 3. OPENING OF THE ABSCESS, either by following up a track of disease in the bone, if such be found, or by deliberate exploration of the surface of the dura mater. In the latter case, as the majority of extradural abscesses lie in the posterior cranial fossa, this should be first explored. The abscess of the posterior fossa usually lies in the sigmoid sulcus, and is "perisinous" in position.

Exploration of the Posterior Fossa.—The position of the sinus is often obvious from the bulging outwards of the inner table of the bone into the operation cavity. When this is not visible, it should be remembered that the sinus lies comparatively superficial. Difficulties in finding it are more commonly due to search being made at too great a depth than from any other cause. The sinus is to be exposed in its descending part. The outer part of the posterior wall of the cavity is cautiously removed in thin layers by the gouge and mallet until the sinus is exposed. In doing so the possibility of nipping the wall of the sinus between the gouge and the farther edge of the groove must never be lost sight of. Should an abscess be found, the bone which forms its outer wall must be entirely removed, so that the whole of the affected area of dura mater is exposed. The sinus wall will often be found covered by granulations, and is in this case easily torn. In the absence of symptoms pointing to thrombosis of the sinus, the most that should be done is to very lightly curette away the superficial and softer layer of granulation tissue, leaving the deeper, more compact layer.

Exploration of the Middle Fossa.—The abscess of the middle fossa lies above the tegmen, and is said to be "supra-tegminal" in position. Abscess in this position not infrequently communicates with the cavity of the tympanum by a narrow opening, draining incompletely and intermittently by this means. If such an opening is found, it should be enlarged, so as to lay bare the whole of the granulating dura mater. If no track is found, the tegmen is removed by the gouge and mallet, beginning at the junction of the squama with the roof of the meatus, and working inwards, so as to lay bare the whole of the area of dura mater above the tympanum and antrum. Any abscess found must be fully opened up, and any area of disease of the dura mater exposed to its limits.

If any difficulty or apprehension is felt in the removal of bone from the surface of the dura mater with the gouge, a small opening only may be made with this instrument, and the remainder of the removal effected by one or other of the bone-cutting forceps, Jansen's nibbling forceps being very useful for the removal of the tegmen in this way.

After a good exposure of the dura mater has been obtained in either fossa, the exploration may be extended, if no pus has been found, by gently introducing the flat dural elevator between the bone and the dura mater, and separating them from each other. In this way a large part of the upper and posterior surfaces of the petrous may be explored. The separation of the dura mater is often followed by rather free bleeding, venous in character: it ceases as soon as the dura is allowed to fall back against the bone.

STAGE 4. EXAMINATION OF THE INFLAMED DURA MATER FOR A SINUS LEADING INTO THE BRAIN.—It is not very uncommon for a brain abscess to lie in contact, and be in continuity with, an extradural abscess. If any evidence of such a condition is found, it must be followed up as directed under Abscess of the Brain.

STAGE 5. COMPLETION OF THE OPERATION.—This will differ in some particulars from the routine of the radical operation, according to the position of the extradural abscess. If this was in the posterior fossa, it is well to keep the posterior incision open for a few days until it is seen that all is going well with the patient, and during this period to conduct treatment through the wound. The sutures may be inserted and their ends tied together. The usual flap is cut of rather ample size, and is best stitched to the lower edge of the temporal fascia, as otherwise it is apt to get pushed down by the packing introduced through the incision behind. A gauze wick is introduced into the tympanum along the meatus, and the remainder of the cavity is lightly filled with gauze plugging through the posterior incision. The usual gauze and wool dressing is then applied, and bandaged in position.

If the abscess was in the middle fossa above the tegmen, the upturned flap, if used, will lie against the surface of the dura mater which it is desired to drain. A down-turned flap may in this case be substituted, or the flap may be entirely cut away; or the meatus may be left for the time intact, treatment being conducted through the posterior incision until the cavity is everywhere healthy. A secondary operation is then carried out on the meatus, with closure of the posterior wound. To form the down-turned flap, the tenotome is made to cut outwards along the roof of the meatus to its junction with the pinna, and is then carried through the concha in a curved direction backwards and downwards and finally forwards, so that a narrow crescentic portion of the concha is included in the flap. The incision ends at the level of the floor of the meatus, and just behind its margin. The soft tissues and cartilage are dissected and removed from the deep surface of the flap, leaving the skin only. The flap will lie on the cut surface of the slope between the meatus and antrum, and should not be sutured. The posterior incision is entirely closed by sutures, and the cavity lightly packed with gauze plugging through the meatus. The dressing and bandage are applied as usual.

After-Treatment.—Except for the possible tying-up of the sutures in the wound, if these have been left loose, the after-treatment of a satisfactory case differs in no particular from that of an ordinary radical operation. The first dressing is done on the third day. All packing is taken out; the cavity is irrigated and repacked. The next dressing will be after twenty-four or forty-eight hours, according to the amount of discharge and the patient's temperature. Subsequently the cavity is dressed each day until healing is complete.

Results.—Of all intracranial complications of otitis media, extradural abscess is by far the least formidable. If discovered and drained before further complications arise, the condition almost always does well. In the majority of cases recovery is absolutely uneventful, and the cavity behaves in every way like that of an ordinary radical operation.

Misfortunes—1. WOUND OF THE DURA MATER.—This may happen either in opening up the abscess or in curetting the granulating dura mater. If it concerns the middle fossa, the danger is of meningitis; if the posterior, the more probable consequence is the opening of the lateral sinus, with troublesome bleeding at the time, and the risk of subsequent infection, or of repeated bleeding at the time of dressing. The greatest care should be exercised in handling the softened and inflamed dura mater.

2. A SECOND ABSCESS, extradural or, worse still, within the brain, may be overlooked. There is a natural tendency in such cases to feel that surgical resources have been exhausted, and to leave the patient in the hope that he will recover, or that some undoubted symptom will appear to justify further interference. In this case the fate of the patient is already, as a rule, sealed, and the effort, if made at all, will be too late to save him. It is a cardinal rule in aural surgery that, if a patient is not progressing, and his symptoms are such as to be possibly explained by the presence of an unrelieved condition arising from the ear, further efforts to discover it and give relief are not merely justified, but are urgently called for.

CHAPTER VIII

THE OPERATION FOR LATERAL SINUS THROMBOSIS

(EXTENSION OF THE RADICAL OPERATION)

THE object of this operation is threefold: to completely remove the infective clot from the sinus; to obliterate the sinus as a blood-channel; and to ligature and, if necessary, excise the internal jugular vein, so closing a possible avenue of systemic infection.

Indications.—The symptoms of sinus thrombosis in a declared case are obvious. At the same time, it may often happen that the diagnosis of sinus thrombosis is only made at the time of, and during the course of, the radical operation. The operation on the sinus is indicated—

1. When there is an undoubted history of repeated rigors in the course of a suppurative otitis media.

2. When there is an obvious firm, tender cord along the course of the jugular vein. Even when the vein is filled by clot, there is, as a rule, so much enlargement of the lymphatic glands and periadenitis that the vein itself cannot be clearly felt.

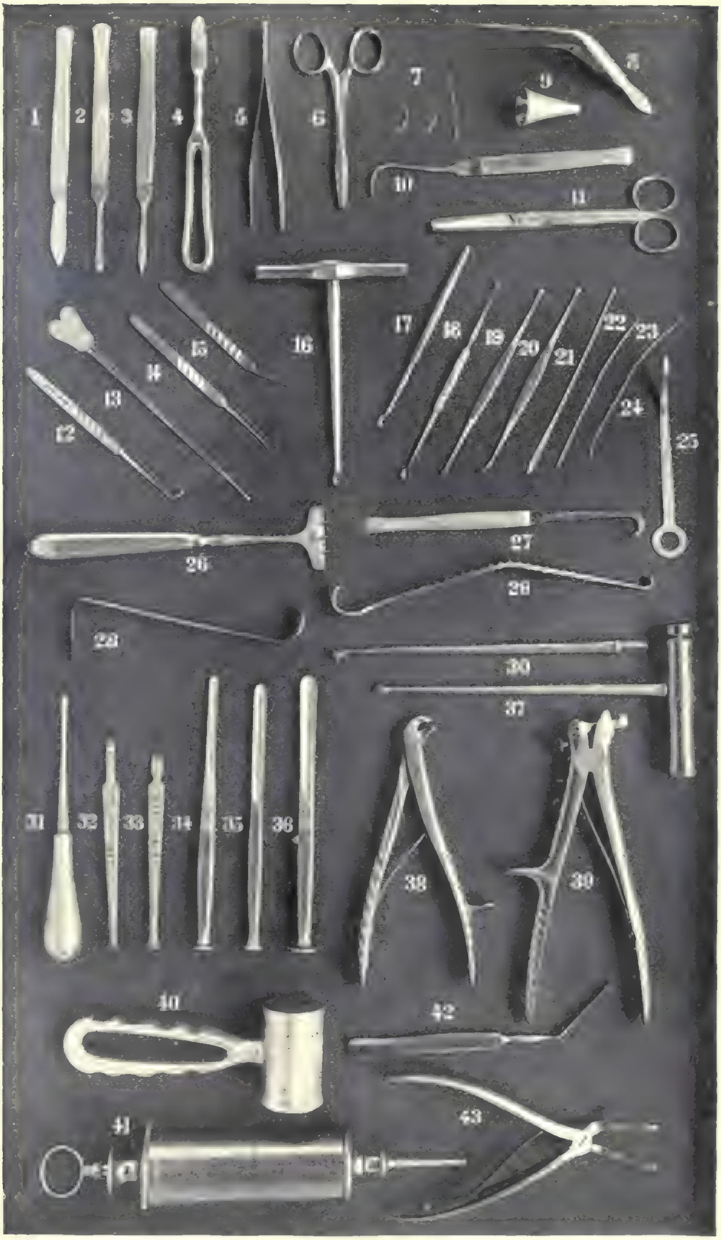
In the presence of marked infiltration along the jugular the presumption is always for either sinus thrombosis or an extradural abscess in contact with the sinus.

3. When, in the course of an exploration of the posterior fossa, the wall of the sinus is found to be sloughing or discoloured, without healthy granulations upon it. Under

INSTRUMENTS FOR THE OPERATION FOR LATERAL SINUS THROMBOSIS.

1. Scalpel.
2. Blunt-pointed tenotome.
3. Sharp-pointed tenotome.
4. Periosteal elevator.
5. Dissecting forceps.
6. Pressure forceps.
7. Needles, straight and curved.
8. Aural forceps.
9. Aural speculum.
10. Aneurism needle.
11. Scissors.
12. Angled steel probe.
13. Director.
14. Angled steel probe.
15. Straight steel probe set at an angle on handle.
16. Cross-handled bone-cutting curette.
17. }
18. } Spoon-shaped curettes.
19. }
20. }
21. }
22. } Silver probes.
23. }
24. }
25. Stacke's guard.
26. Rake-shaped retractor.
27. Two-pronged retractor.
28. Retractor for meatal wall.
29. Retractor for insertion through the meatus (Heath's).
30. Hand burr, fits into the handle shown in Fig. 37.
31. Small round-nosed chisel.
32. } Straight-edged chisels.
33. }
34. }
35. } Gouges.
36. }
37. Hand burr with cross handle (Heath's).
38. Horsley's nibbling bone forceps.
39. De Vilbiss's bone-cutter.
40. Hammer.
41. Syringe.
42. Dura mater elevator.
43. Jansen's nibbling bone forceps.

Plate XI.



INSTRUMENTS FOR THE OPERATION FOR LATERAL SINUS THROMBOSIS.

To face page 90.

such circumstances there is usually a perisinous abscess, and on pressure on the sinus its contents exude as a mixture of pus and broken-down blood-clot. Or when the lumen of the sinus is palpably filled by solid clot.

4. Thrombosis may be limited to the jugular bulb. If complete, there is no added turgidity of the sinus when the jugular vein is compressed. In any case, unless very early, there will have been rigors. These alone, if admitting of no doubt, are a sufficient indication for the performance of the operation.

The diagnosis is sometimes rendered difficult by the symptoms of a concomitant meningitis, of a secondary septic pneumonia, or of a septic diarrhœa of typhoid type. Confusion with typhoid fever is perhaps the commonest pitfall in the diagnosis. The presence of an aural discharge and of a high leucocytosis, with local pain and tenderness along the jugular, should serve to prevent this fatal mistake.

Contra-indication.—Proptosis of the eye and chemosis of the conjunctiva are evidence of infection of the cavernous sinus, and form an absolute contra-indication to operation.

General Preparation of the Patient.—The operation is one of urgency, and no time should be lost over anything but the most essential preliminaries.

Local Preparation.—The whole of the side of the head should be shaved, from the temple back to the occiput. The ear is now thoroughly syringed out, and a gauze wick is passed along the meatus. The shaven area and the whole side of the neck down to the clavicle are to be prepared by lightly scrubbing with soap and water, rubbing well first with ether, then with spirit lotion (biniodide of mercury, 1 in 500, in equal parts of alcohol and water), and finally washing over with 1 in 4,000 watery solution of biniodide of mercury. If there is time this rather lengthy procedure is best done before the patient is put on the table, and in this case the whole area is covered with gauze wrung out of 1 in 4,000 biniodide lotion, and encased in wool and bandage.

Surgeon's Outfit—INSTRUMENTS.—Two sets will be required: (1) for the operation on the ear and sinus, and (2) for that on the neck. They must be kept separate throughout, and the second set (for ligature of the vein) should not be put on the table until actually required. Those for the operation on the sinus will be the same as for the radical operation. For ligature of the jugular vein will be required, in addition:

Scalpel.
Scissors.
Two dissecting forceps.
Six pressure forceps.
Pair of small retractors.
Probe-director.
Aneurism needle.
Sterilized catgut.
Straight needle.
Silkworm gut.
Small drainage-tube.

LOTIONS.—For hands, and to wash over the surface before the incisions are made, 1 in 500 spirit lotion; for use during the operation, 1 in 4,000 biniodide in water.

DRESSINGS.—Besides the usual-shaped dressing to fit behind the ear, two large gauze and wool dressings should be prepared—one for the side of the head, one for the neck. An extra bandage will be required. Cut plugging may be required in quantity, and should be prepared in various widths, from ¼ inch to 1 inch, of fourfold thickness.

Culture-tubes, spirit-lamp, platinum loop, will also be required.

Operative Tactics.—The patient is in the dorsal position, the head supported on a low, firm pillow, and turned somewhat to the opposite side. Round the head is pinned a towel, passing over the forehead and occiput. Towels are arranged to cover the neck and body at least down to the waist. Later the neck is exposed, and the side of the head is covered by a towel.

The surgeon stands at the affected side of the patient's head; his assistant is at the head of the table; the anæsthetist stands at the opposite side of the patient's head. The instrument-table is on one side of the surgeon.

Anæsthetic.—Chloroform is indicated on all counts: the operation is a severe and prolonged one; delay caused by hæmorrhage during the preliminary radical operation is most undesirable; and the patient's lungs may already contain septic infarcts. The administration of ether in these cases is strongly contra-indicated.

Technique of the Operation.—STAGE 1. PERFORMANCE OF THE RADICAL OPERATION, or, in the rare cases of sinus thrombosis in acute otitis media, of Schwartze's operation.

STAGE 2. OPERATION ON THE SINUS.—The descending part of the sinus is first exposed by cutting away the bone which covers it and forms the posterior wall of the mastoid cavity. The removal is commenced quite superficially, and it is to be remembered that the lateral sulcus lies, as regards its outer edge, at the angle of junction of the inner surface of the mastoid with the posterior surface of the petrous. The exposure is best commenced with the broad gouge and mallet. As soon as the sinus is seen, the difficulty is over, and the bone may be freely removed. At least $\frac{3}{4}$ inch of the sinus should be exposed for the preliminary investigation. A thrombosed sinus rarely admits of doubt as to its condition, but cases of adherent partial clot occur, in which the operation must be proceeded with on the symptoms only.

STAGE 3. LIGATURE AND DISSECTION OF THE JUGULAR VEIN.—This should be carried out as soon as it has been determined to proceed further with the operation. In cases in which the diagnosis is confidently made, it may be desirable to make the operation on the vein the first part of the procedure. The instruments hitherto in use are put aside, and the other set is placed on the table. The dressing is removed from the neck, and the skin washed over with spirit lotion. The line of incision is along the anterior border of the sterno-mastoid muscle, and extends from the tip of the mastoid process to the level of the middle of the thyroid cartilage. The skin, platysma, and superficial fascia are divided, and the external jugular vein is exposed. This is divided between ligatures. The deep fascia is next incised along the border of the sterno-mastoid, and the muscle is retracted backwards. The upper deep cervical glands are, as a rule, much swollen, and obscure the internal jugular vein. It is best to rapidly remove them, thus exposing the vein to which they may be adherent. The condition of the vein is now investigated. If thrombosis extends beyond the limit of the incision, this must be lengthened downwards, and the vein followed until the limit of thrombosis is reached. Either at the level of the upper border of the thyroid, or clear of the lower limit of thrombosis if it extends beyond this, a double ligature is passed round the vein, and its two parts tied, with ½ inch interval between them. The vein is now divided and dissected up, the common facial and lingual veins being tied and divided. The dissection is carried upwards until the tip of the finger can feel the attachment of the vein to the edge of the jugular foramen. The vein is left long, with the ligature attached. The wound in the neck is now filled with gauze, and the incision covered with a large gauze pad.

STAGE 4. INCISION AND EMPTYING OF THE SINUS AND JUGULAR BULB; REMOVAL OF THE VEIN ABOVE THE LIGATURE.—It is essential that the whole of the thrombosed part of the sinus should be exposed. This may be effected with the gouge and mallet, or with bone-cutting forceps. The descending limb is first exposed from the upper to the lower bend. If the upper end of the thrombosis has not been reached, an incision is now carried backwards in a horizontal direction from the level of the upper margin of the mastoid cavity to a point about three-quarters of the way to the external occipital protuberance. This divides all tissues down to the bone. The edges of the incision are elevated for ½ inch on each side. The occipital artery and some of its branches are cut, and require to be tied at both ends. The removal of bone is now extended backwards until the limit of thrombosis is reached. A strip of gauze plugging is now pushed between the sinus and the bone behind the limit of the clot, so as to firmly compress the walls of the sinus against each other. A short incision is made into the sinus in a part which is obviously thrombosed, a portion of the clot removed for cultivation, and the sinus rapidly opened on a director towards the gauze plug. The clot is curetted away. If bleeding occurs from the mouth of veins opening into the inner wall of the sinus, it is easily controlled by filling the sinus with gauze as the clot is removed. If it is found that clot is still present at the limit of the exposure of the sinus, more bone must be removed, while pressure on the sinus is maintained, the skin incision being lengthened if necessary. The incision into the sinus is now carried downwards to the point where it turns inwards upon the basi-occipital. Any bleeding which may occur comes from the inferior petrosal sinus, and is easily controlled by introducing plugging between the sinus and the bone. All clot is curetted away from the lower part of the sinus, and the spoon is pushed inwards, and the upper part of the jugular bulb cleared out. If the outer wall of the sinus is sloughy, it is best to trim its edges away with scissors.

The pad is next removed from the neck, and the vein is brought out on top of the gauze packing. A grip is taken on each side of the vein by pressure forceps about 1 inch below the highest point exposed, and the lower part is cut away. The edges of the vein are held apart, and its channel emptied of clot. The curette will pass up into the jugular bulb, and this should also be curetted out. The bulb is now syringed out from below through the open vein : the lotion should run out freely at the opening in the sinus. A catgut ligature is placed round the end of the vein as high up as can be reached, and the vein is cut off short and allowed to fall back into the wound.

STAGE 5. SUTURE OF THE WOUND IN THE NECK; COMPLETION OF THE OPERATION.—The packing is removed from the wound in the neck, which is well irrigated. A tube of moderate calibre (about a No. 12 male catheter), and well furnished with lateral openings, is laid in the wound from top to bottom, and fixed at the lower angle by a suture. The whole length of the wound is now sutured. The gauze plugs controlling the posterior end of the sinus, and, if one is needed, that at its lower end, are renewed, and the open channel of the sinus is filled with gauze, which is lightly packed into the wound until it is completely filled. The mastoid cavity is packed independently. No attempt is made to close any part of this wound.

The whole of the side of the head and neck are now enveloped in a plentiful gauze and wool dressing, and secured by a bandage.

When the area of thrombosis is localized, so extensive an operation is neither necessary nor advisable. If the clot does not extend downwards into the bulb, the vein need not be resected; it will suffice if it is tied at the level of the upper border of the thyroid cartilage, and the sinus obliterated below the thrombus. The incision in the neck in this case need not be more than 1½ inches long, and it will not be necessary to drain it. The second incision backwards from the primary mastoid incision should not be made until it is found that the thrombus extends into the horizontal part of the sinus.

After-Treatment.—The operation is necessarily a severe one, and shock, especially in children, is often marked. It must be met on the usual lines—by elevation of the foot of the bed, saline injections into the rectum or cellular tissues, and hot bottles. If there is much restlessness and complaint of pain, a small dose of morphia may be given hypodermically—⅙ to ¼ grain in an adult. As there is always good ground for presuming that a case of sinus thrombosis is due to the *Streptococcus pyogenes*, it is rational to give an immediate dose of 20 c.c. of antistreptococcic serum, which may be injected on the table or immediately after return to bed. While there are few cases in which it seems to do any good, it never appears to do harm. A smear of the clot will probably afford immediate microscopical evidence of the nature of the dominant organism present. The cultures should be hurried forward as quickly as possible, and if a streptococcus is grown, its reactions to Gordon's sugar tests should be investigated. Various diphtheroid organisms are of common occurrence in the clot from a thrombosed lateral sinus; they are of no pathogenic importance, and are merely saprophytes which have migrated from the middle ear.

The prognosis in a case of sinus thrombosis is exceedingly grave, and the after-treatment will be largely regulated by the presence or absence of further septic complications. Treatment will be first described in a case in which a general blood-infection has been anticipated by the operation, and in which no further spread takes place. Later, the patient's condition and its requirements under various circumstances will be discussed.

After-Treatment of the Wounds.—If care has been exercised during the operation, **the incision in the neck** should heal by primary union. The tube is removed at the first dressing on the third day, and the stitches on the sixth or seventh day. **The open mastoid and cranial incision** gives more trouble, as it has of necessity to heal by granulation. In addition, it is common for more or less necrosis of the cut edges of the bone to occur, causing delay in healing. Sloughs of dura mater and periosteum have often to be cast off. If much oozing has followed the operation, the patient will be made more comfortable if the external dressing is changed on the day following the operation. The plugging must not be disturbed; any attempt to remove the plugs from the sinus at this time will be certainly followed by bleeding. On the next (third) day, the first complete dressing is carried out. The cervical incision is first dressed, the upper wound being isolated by a sterile towel. The tube is removed, and a fresh gauze and wool dressing applied and temporarily bandaged. The plugging lying in the mastoid cavity and along the open sinus is well soaked in lotion, and gradually removed; it will be found adherent to the edge of the skin incision, and its removal is very painful. It should be carefully peeled off with dissecting forceps. Once this difficulty is surmounted, the remainder of the removal is easy until the deepest part of the plug in the mastoid is reached. A little gentle firmness is often needed here, in combination with patient syringing. Without disturbing the plugs controlling the sinus, the whole of the wound is now well irrigated and inspected, so that, if bleeding takes place at the next stage, fresh plugs may be inserted and the dressing promptly terminated. In removing the plugs from the sinus, much depends on the care and skill of the surgeon. The gauze should be grasped in dissecting forceps, and very gently withdrawn by twisting it axially, not by direct traction. In this way it is peeled off the sinus with very small risk of dragging its already adherent walls apart. After each plug is removed it is replaced by a fresh one lightly introduced. The wound in the bone and mastoid is now lightly but completely filled with gauze, a plentiful gauze and wool dressing applied, and the bandage on the neck removed if it has become soiled. Both dressings are now included in a bandage which completely envelops them.

Dressings must subsequently be made daily. At the second dressing the plugs on the ends of the sinus are finally removed. If all is well with the wound in the neck, it will require nothing beyond a daily inspection until the stitches are removed on the sixth or seventh day. In a week or ten days the exposed bone and dura mater should be showing granulations, but delay may be occasioned by a sloughy condition of the dura mater, and at this time the absence of granulations on the bone does not necessarily mean necrosis. If all goes well, at the end of a fortnight a secondary operation may be undertaken to make a meatal flap, if this was not done at the former operation, and to close the upper part of the mastoid wound. If this is not done, the edge will become turned inwards in front, and the ear will, in addition, tend to drop to a lower level than that of the opposite side. Areas of necrosis should be left until they are loose, or at least well defined, before any attempt at removal is made. Complete healing may be a very slow process.

In a case proceeding without further complications, the patient's general condition improves rapidly after the operation. The temperature falls, either immediately or by diminishing excursions, to the normal. No great alarm need be felt if a rigor occurs during the first twenty-four hours. Successive leucocyte counts should show a diminishing number with the fall of temperature. As the general preparation of the patient may possibly have been inadequate, it is well to give an aperient twenty-four hours after the operation. A return to a normal diet will be determined by the patient's temperature and appetite.

Septic Complications which may arise—1. INTRACRANIAL INFECTIONS. — Meningitis; cerebral abscess; cerebellar abscess; spread of infection to other sinuses. The meningitis, which is secondary to thrombosis of the lateral sinus, is due to an extension from purulent thrombosis of the cortical veins which open into the sinus, and is distributed along their course over the side of the hemisphere. It is not, as a rule, accompanied by the typical symptoms of meningitis; the picture is rather that of an intense toxæmia. The patient is, in fact, already septicæmic. The temperature is high and sustained; the mind is in the early stages clear; headache may be complained of; vomiting is rarely marked; there are often fibrillary twitchings of the face, arm, and leg; the reflexes may be quite normal. Later, there is unconsciousness, and death from heart failure. There is no possible treatment of this condition.

Cerebral abscess is less common than cerebellar as a complication of sinus thrombosis. If not masked by other circumstances, its symptoms will manifest themselves in the ordinary way (see Cerebral Abscess).

Cerebellar abscess is caused by the direct contact of the most outward part of the lateral lobe with the deep surface of the sinus. In post-mortems on cases of sinus thrombosis the course of the sinus is always visible on the cerebellum as a dark greenish stain, lying along the groove which is normally caused by the sinus. It is immediately under this area that the cerebellar abscess is found in cases of sinus thrombosis (for symptoms and treatment see Cerebellar Abscess).

2. PYÆMIC COMPLICATIONS — In the thorax: infarctive pneumonia, purulent pleurisy, pericarditis. In the abdomen: enteritis, peritonitis, infarction of kidneys, spleen, etc. Pyæmic joint abscesses; subcutaneous abscesses. All these complications must be met on general surgical and medical lines.

HÆMORRHAGE FROM THE LATERAL SINUS.

It may be well to add a few words on the subject of hæmorrhage from the lateral sinus. When uncontrolled, this is so tremendous that if seen for the first time it is enough to unnerve any operator who is taken by surprise. It may always be readily controlled by pressure, and the finger placed on the open sinus at once stops the escape of blood, till the surgeon has got ready the means of permanently controlling it. This is done by plugging on, not into, the sinus, the gauze being introduced between the sinus and the bone, and pressing the walls of the sinus against each other, so that they may become adherent to each other. The only real trouble is when the blood issues from the mouths of numerous veins opening on the inner surface of the opened sinus. The channel must be filled with gauze, and pressure kept up for a few minutes, after which hæmorrhage will usually cease. No dressing on a sinus case should ever be begun until all preparations for coping with recurrent hæmorrhage are made.

If the plugs have been properly introduced, there is no danger of bleeding from an opened sinus until they are displaced at the next dressing.

CHAPTER IX

THE OPERATION FOR TEMPORO-SPHENOIDAL ABSCESS

(EXTENDED RADICAL OPERATION)

THE object of this operation is to open and drain an abscess in the temporo-sphenoidal lobe of the brain, secondary to suppurative otitis media.

Indications.—The classical symptoms of abscess of the brain are: (1) Headache; (2) vomiting; (3) optic neuritis. When these are undeniably present in a case of suppurative otitis media, the diagnosis of abscess may be made with a fair degree of certainty, though it is still doubtful where the abscess is situated. Unfortunately, the value of the symptoms individually is not so great, and optic neuritis is a rare occurrence in the acute and subacute abscess of aural origin. Of the remaining two, headache is a common feature of all conditions which are accompanied by inflammation of the dura mater, of lepto-meningitis, and of encephalitis, whether affecting the cerebrum or cerebellum. Vomiting also may be the consequence of meningitis, of severe septic absorption, or of brain abscess. The most that can be said for these three symptoms is that all cases of cerebral abscess have more or less headache, and nearly all vomit at some time, and that a few show well-developed optic neuritis. Unilateral paralyses may occur; they will affect the opposite side. Motor aphasia is sometimes caused by a left-sided abscess. Either of these symptoms is of great value when present; both are rare and late symptoms.

The operation for temporo-sphenoidal abscess must generally be undertaken on a probable diagnosis based on the patient's general condition. The most important features in this are:

1. A certain dulness of mind, a difficulty in giving sustained attention to questions, and a tendency to lie in a passive, somnolent condition; when roused and questioned, the patient probably complains of headache.

2. The character of the pulse. This may become progressively slower, falling to the lower fifties in an advanced case, and gradually assuming a peculiar and very suggestive type. The pulse-wave is soft, its rise gradual, its crest prolonged, and later may be distinctly dicrotic.

3. Along with this slowing of the pulse there is a progressive fall of temperature, which becomes subnormal. If the temperature which has assumed this type suddenly rises to 101° F. or more, it is almost certain evidence that an abscess has burst into the ventricle or on the surface. If the escape is into the ventricle, sudden loss of consciousness occurs, which is not recovered from. There may be an initial general convulsion.

4. As the pressure deepens, the respiration assumes a modified Cheyne-Stokes' rhythm; successive inspirations become more and more shallow, until, just before they seem about to cease, a deep prolonged inspiration is taken. The cycle is then recommenced. In the end a time comes when the inspiratory effort is not made, and the patient dies of respiratory failure. Once this character has been assumed by the breathing, the patient may cease to breathe at any time without further warning. No efforts at artificial respiration are of any avail to start natural breathing, and an instant effort to find and open the abscess should be made, while the patient is kept alive by artificial respiration. Along with this change in the breathing, the patient's general condition has passed into complete unconsciousness.

General Preparation of the Patient.—As soon as the surgeon's mind is made up as to the probable presence of a temporo-sphenoidal abscess, the operation becomes one of urgency. Such general preparation as is possible should of course be carried out. An enema may be given if the patient is conscious, and a catheter passed if the patient is unconscious, or has a difficulty in passing water.

Local Preparation.—The lower half of the side of the head is to be shaved, lightly scrubbed with soap and water, rubbed with ether, then with spirit lotion. This is washed off with 1 in 4,000 watery solution of biniodide, and, if the preliminary preparation is being done off the table, a plentiful dressing is applied.

Surgeon's Outfit.—All instruments as for the radical operation; in addition, a suitable instrument for exploring the brain. The one figured has been devised by one of us for this purpose.

Lotions, swabs, head-lamp, apron, gloves, towels, drainage-tubes, dressings, bandage, as for the radical operation.

Operative Tactics.—The positions of the surgeon, his assistant, and anæsthetist will be as for other major operations on the ear.

Anæsthetic.—If the patient is deeply unconscious there may be no need for an anæsthetic, but in any case an anæsthetist should be present. The anæsthetic should always be chloroform in these cases, and should be most cautiously administered. The patient may stop breathing at any moment; in this case artificial respiration should be immediately begun, and the operation proceeded with.

Technique of the Operation — STAGE 1. PERFORMANCE OF THE RADICAL OPERATION. — This must be done as rapidly as possible, a thorough exposure being obtained. Particular attention should be given to the roof of the cavity.

STAGE 2. EXPOSURE OF THE DURA MATER OF THE MIDDLE CRANIAL FOSSA.—This is effected by removing the whole of the roof of the operation cavity. The bone is often very thin and elastic, and as soon as dura mater is exposed it is often quicker and more convenient to complete the removal with bone-cutting forceps. An area of dura mater 1 inch across is ample for the exploration of the temporo-sphenoidal lobe.

STAGE 3. INSPECTION OF THE DURA MATER.—This is carried out to discover—(1) if its texture and surface are normal; (2) its tension. Increased tension is evidenced by —(*a*) bulging; (*b*) the absence of pulsation. The dura mater outside an abscess is often inflamed and thickened. If an extradural abscess has been present over the exposed area, the dura mater may be discoloured and necrotic, and a fistula may lead into the brain. Bulging of the dura mater is only evident when a considerable area is exposed, and is generally accompanied by absence of pulsation. Both these signs are evidence of increased intracranial tension only, and are no direct evidence of the existence of an abscess. Their presence in a suspicious case should lead to an exploration of the overlying brain.

STAGE 4. SYRINGING AND DISINFECTION OF THE CAVITY WITH 1 IN 20 CARBOLIC.

STAGE 5. INCISION OF THE DURA MATER; EXPLORATION OF THE BRAIN.—An incision should be made about ¾ inch long through the middle of the exposed dura mater, or through a fistulous opening, if one is present. It is made very carefully, so that the dura mater only is penetrated. If an abscess is present, the brain is often adherent to the dura mater. If the tension is increased, the brain will bulge into the gap. The exploring instrument is now pushed into the brain directly upwards, and its blades separated after they have penetrated about ¾ inch. If no pus is found, the instrument is withdrawn, re-entered through the same puncture, and passed forwards above the tegmen and a little upwards, and again opened. If failure again results, trial should next be made in a direction backwards and upwards. It is of little use to go more deeply into the brain, for temporo-sphenoidal abscess always lies at its lowest part close to the surface. If an abscess is not found, the lateral ventricle should be explored. The explorer is pushed directly upwards above the antrum to a depth of 1½ inches. If the ventricle is found to contain fluid under pressure, the patient has either an undiscovered abscess, probably cerebellar, or has meningitis.

If an abscess is found, the exploring instrument is carefully kept in place by the assistant. A rubber tube of good size is then passed into the cavity between the blades of the explorer, and the latter is gently withdrawn. The tube should be fixed by a suture to the edge of the incision in the dura mater.

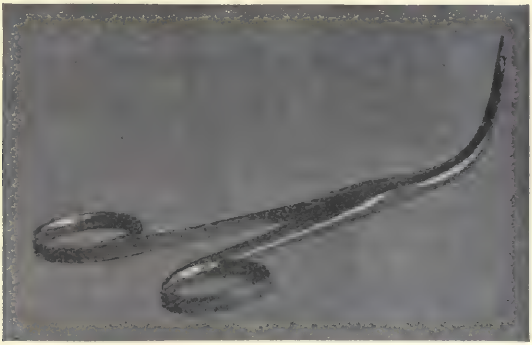


FIG. 3.—EXPANDING TROCAR FOR EXPLORATION OF THE BRAIN.

Completion of the Operation.—It is well to make no attempt for the time to formally complete the operation by making a meatal flap, but rather to leave the wound open until the result of the opening of the abscess is seen. The bony cavity is loosely filled with gauze, and an outside dressing is applied and bandaged.

After-Treatment.—A strict watch must be kept on the patient during the first few hours, as, in spite of the relief of tension, he may still stop breathing without warning. As a rule, the condition is much improved from the first: the pulse, on opening the abscess, becomes suddenly more frequent, and may pass from 60 to 120 or more; the breathing becomes easy and of natural rhythm. There may soon be a marked rise of temperature. Consciousness is recovered, and the headache disappears. The wound should be dressed on the second day, and the tube cleared by passing a pair of aural forceps armed with cotton-wool through it into the cavity. Subsequently daily dressings are carried out in the same way. The tube is not disturbed before the fourth day, when the suture holding it is cut and the tube withdrawn. It will be found that the cavity of the abscess has collapsed, and that the track of the tube is all that remains. The tube may be shortened by ¼ inch, and must be reinserted. It is on no account to be replaced by a smaller tube. The shortening of the tube is carried on, till at the end of ten days its intradural part will probably be reduced to a length of ½ inch, its calibre being always maintained. It may now be completely withdrawn. If all is well, at the end of another week the plastic operation on the meatus may be carried out, and the case treated like a routine radical operation.

Results.—A healed temporo-sphenoidal abscess appears to leave no mark on the patient, and he may recover, in every way a sound man. It is, however, unfortunately true that many cases of cerebral abscess disappoint the surgeon, in spite of their having been found, opened, and drained. In some of these cases the reason is that they have been opened too late, and the patient never recovers from the stage of compression. No relief seems to be given, consciousness is not restored, and the patient dies a few hours after the operation. In others there is a temporary improvement, but the patient manifests after a few days a return of the symptoms of compression. This may be caused (*a*) by inadequate drainage and reaccumulation of fluid in the cavity; (*b*) by the presence of a second abscess, either in the temporo-sphenoidal lobe, in front of that found, or in the cerebellum; (*c*) by ventricular distension; (*d*) by the occurrence of a diffuse infective œdema of the brain about the abscess which has been opened. The first possibility is easily treated or excluded. If no reaccumulation is found, a further exploration should be made without delay. In the treatment of the diffuse œdema it is imperative to encourage free herniation of the brain by making a wide opening in the dura mater.

If good results are to be obtained in abscess of the brain, the surgeon must be prepared to explore on evidence which amounts to much less than certainty, and to accept the responsibility on occasion of having fruitlessly done so. The risk which this carries is a small one, if care is taken to disinfect the cavity before opening the dura mater. If the brain has been explored, it is better to leave the wound in the dura mater open, rather than to attempt to suture it. If infection has not been carried into the brain by the exploring instrument, there seems practically no risk that it will make its way subsequently through the incision.

CHAPTER X

THE OPERATION FOR CEREBELLAR ABSCESS

(EXTENDED RADICAL OPERATION)

THE object of this operation is to open and drain an abscess in the cerebellum, secondary to suppurative otitis media.

Indications.—Of all the intracranial complications of otitis media, cerebellar abscess may be the most obscure. It is especially liable to be confused with meningitis of the base and posterior fossa, of aural origin, or with an ordinary tuberculous meningitis. The symptoms most usually present may be summarized as those of diffuse intracranial pressure, with retraction of the head. It is not an infrequent secondary complication of infective labyrinthitis, lateral sinus thrombosis, or infective disease of the posterior part of the petrous.

HEADACHE may be said to be constant, often frontal or occipital in position.

VOMITING is probably always present, but may be very occasional, or occur only in the early stages.

OPTIC NEURITIS is said to be more constant in cerebellar abscess than in any other form of abscess of the brain. In our experience, however, it has been extremely rare, and we have ceased to consider its absence as of any value one way or another.

TEMPERATURE.—The temperature in cerebellar abscess of otitic origin is generally raised, and often unsteady.

PULSE—RESPIRATION.—The pulse has the "cerebral character"—soft, with a slow rise and prolonged wave. It may be slower than the ordinary rate which may be expected in correspondence with the temperature. Until a late stage the respirations may be slightly frequent; the rate is apt to be comparatively constant, in spite of the variation in temperature. Towards the end the modified Cheyne-Stokes rhythm may appear. Death takes place through failure of respiration, caused by pressure either directly by the abscess or through ventricular distension.

RETRACTION OF THE HEAD is one of the most constant symptoms in cerebellar abscess, ranging from a mere stiffness on flexion to strong retraction, in which the slightest attempt at passive flexion causes great pain.

CONSCIOUSNESS and the activity of the mental processes are not interfered with until a late stage.

REFLEXES.—The knee-jerk on the affected side, or on both sides, may be increased, and may take the form of a prolonged spastic contraction, or of a clonus. Kernig's sign is generally markedly present. The plantar reflex varies; opposed responses may often be obtained from successive strokings.

LATERAL NYSTAGMUS occasionally occurs.

HYPOTONUS and MUSCULAR INCO-ORDINATION may be found.

LUMBAR PUNCTURE discovers an excess of cerebro-spinal fluid, under raised tension. The fluid is clear or slightly turbid, sterile, and on centrifugalization is found to contain a variable number of polymorphonuclear leucocytes. Its cell contents afford a valuable aid in the diagnosis from tuberculous meningitis.

General Preparation of the Patient.—In all cases of abscess of the brain operation should be carried out as soon as the diagnosis is made. No undue delay should be allowed in order that a formal general preparation may be gone through. An enema may be given where time admits, and the patient's bladder must be emptied.

Local Preparation.—The head should be shaved for

3 inches above the ear and from the temple to a point 3 inches behind the meatus. The shaved area is then lightly scrubbed with soap and water, rubbed with ether, then with spirit lotion. This is washed off with 1 in 4,000 watery solution of biniodide of mercury, and, if the preliminary preparation is done beforehand, a plentiful dressing is applied.

Surgeon's Outfit.—All instruments as for the radical operation; in addition, the expanding brain-exploring trocar.

Lotions, swabs, head-lamp, apron, gloves, towels, drainage-tubes, dressings, bandage, as for the radical operation; in addition, culture outfit.

Operative Tactics.—The surgeon, his assistant, and anæsthetist are placed as for the radical operation.

Anæsthetic.—Chloroform should always be used. It must be cautiously administered, and overdose most carefully avoided. Artificial respiration must be maintained if necessary while the operation is completed.

Technique of the Operation:

STAGE 1. PERFORMANCE OF THE RADICAL OPERATION.—This must be done as rapidly as possible, a thorough exposure being obtained. Particular attention should be given to the outer wall of the labyrinth and to the posterior wall of the cavity. If disease or necrosis of the labyrinth is found, it should be appropriately dealt with (see Operations on the Labyrinth).

STAGE 2. EXPOSURE OF THE DURA MATER OF THE POSTERIOR CRANIAL FOSSA.—Two routes are available for the opening of a cerebellar abscess—viz., to the inner or outer side of the lateral sinus. It is a general rule that any abscess of the brain of otitic origin lies in close relation with an infected area of bone or dura mater, from which bacteria have invaded the meninges, and, passing across an area of adhesion, have then spread to the underlying brain. In the case of cerebellar abscess, the focus of infection lies on the posterior surface of the petrous, extending backwards from the antrum or from the labyrinth. Infection from the antrum may pass across the lateral sinus, producing thrombosis in its course, or through the dura mater internal to the sinus. It is unlikely ever to pass outside the sinus. Infection from the labyrinth may take one of two quite distinct courses, passing either through the cancellous bone, which lies between the semicircular canals, and so reaching the posterior surface of the petrous, or through the inner wall of the vestibule into the internal auditory meatus, and so along the seventh and eighth nerves to the deeper part of the anterior aspect of the cerebellum. The depth of the abscess from the outer pole of the lateral lobe will thus vary, but in nearly all cases the shortest route through cerebellar tissue to the abscess will be from the anterior aspect. In exploring to the inner side of the sinus, we get the advantage of a more direct path, and one along which, if an abscess is present, the meninges are probably adherent to the brain. By the outer route, on the other hand, there is less risk of carrying in infection, as the incision through the dura mater is outside the limit of infection in the bone. The risk of failing to find an abscess which is present in the cerebellum is so much the greater that the inner route is nearly always preferable. It is a travesty of surgery to explore the cerebellum for an otitic abscess through a trephine hole, while leaving the antrum and middle ear untouched.

If the inner route is followed, the dura mater should be exposed by the removal of the whole of the posterior wall of the operation cavity, commencing from its outer limit and laying bare the inner margin of the lateral sinus. An area of dura mater measuring from without inwards at least $\frac{3}{4}$ inch must be obtained, and the inner wall of the antrum should be cut away in a direction directly inwards. If a sufficient exposure cannot be otherwise obtained, the region of the external and posterior semicircular canals should be removed. As infection may have passed along the internal auditory meatus, the dura mater over an abscess may appear perfectly normal. If any nervousness is felt in cutting directly inwards on the dura mater with the gouge and mallet in the deeper part of this removal, a flat dural elevator may be passed between the dura mater and the bone, and so afford a protection. It must be held in position by the chief assistant.

To expose the dura mater for the outer route a short cross incision will be needed, carried backwards from about the middle of the primary incision for 1 inch. The scalp tissues are elevated at its edges, and any bleeding vessels secured; as a rule, a branch of the occipital artery is cut. The two triangular flaps so formed are held aside by small retractors. The sinus is now exposed by cutting away the outer part of the posterior wall of the cavity, and the removal of bone is continued backwards until an area of dura mater is exposed behind the sinus at least ½ inch broad and ¾ inch from above downwards.

STAGE 3. INCISION OF DURA MATER; EXPLORATION OF CEREBELLUM.—The line of incision in the dura mater will vary according to the route chosen: if internal to the sinus, the tenotome is made to cut through the dura mater horizontally, care being taken to keep the edge of the sinus in view, and to avoid notching it; if outside the sinus, the incision should be behind, and parallel to, the edge of the sinus. In either case the opening in the dura mater should be at least ½ inch long, and care should be taken to avoid injury to the superficial vessels of the cerebellum. The expanding trocar is now passed into the cerebellum—in a direction backwards and inwards if through the inner route, directly inwards if through the outer; in both cases also slightly upwards. It should always be remembered that a cerebellar abscess lies, as a rule, close to the anterior surface of the lateral lobe, and about the level of its anterior border—*i.e.*, on a level with the superior border of the petrous—and that too deep penetration endangers vital centres if the exploration is conducted at a lower level. If an abscess is found, a drainage-tube is passed in between the blades of the trocar, and this instrument is withdrawn. The tube may be fixed by a suture to the edge of the dura mater. If an abscess is not found after the first puncture, a second should be made, directed somewhat further backwards. There is a peculiar difficulty in finding a cerebellar abscess, and it is quite possible to miss one even after so thorough a search as this procedure implies.

STAGE 4. COMPLETION OF THE OPERATION.—If an abscess has been found, the after-treatment will be carried out through the incision, and this must consequently be left open. It is well in this case to defer the plastic operation on the meatus until a later period. The tube is adjusted in the corner of the wound, and the whole cavity is lightly filled with gauze plugging. The usual gauze and wool dressing is applied, and fixed by a bandage.

After-Treatment.—As in cases of cerebral abscess, a most careful watch must be kept on the patient during the stage of recovery from the anæsthetic, as breathing may become arrested unexpectedly. On the second day the dressing is removed, plugging taken out, and the tube gently cleared with wool on aural forceps. The cavity is then again lightly packed with gauze round the tube, and the outside dressing is renewed. Subsequently daily dressings will be necessary. After the fourth day the tube should be removed at each dressing, and after the end of a week it may be daily shortened. The part of the tube within the cerebellum is always a short one, and as soon as the track passes no further than the surface of the dura mater, the use of a tube may be abandoned. The plastic operation on the meatus may now be completed (see the account of the Radical Operation), or the wound behind the ear may be kept open and plugged from the bottom daily till complete cicatrization has taken place.

Results.—In cerebellar abscess there is no half-way house as regards results: the patient either gets completely well or dies. In successful cases recovery is rapid; there is no residual incapacity or affection of mental power. In fatal cases the patient, as a rule, shows no improvement from the operation, and dies within a day or two.

Misfortunes.—The greatest of all misfortunes is to miss the abscess. In this case the surgeon is apt to feel discouraged, and to abandon further efforts for its discovery. A cerebellar abscess may easily be entirely overlooked. The lateral sinus may be wounded in making the incision through the dura mater, and much embarrassment caused. The cerebellum may be fruitlessly and, in the event, needlessly explored. This possibility should not baulk the operator ; if he thinks the patient is in grave danger to life, the risk must be taken. To wait for certainties in these cases is to abandon most of the patient's chances.

CHAPTER XI

OPERATIONS ON THE LABYRINTH

INFERIOR VESTIBULOTOMY.

By inferior vestibulotomy is meant the opening of the vestibule from the tympanum below the facial nerve. Its object is to secure drainage of the cavity of the labyrinth, and to enable the destruction of the ampullary nerve-endings. It is also used as the route to the Internal Auditory Meatus in Translabyrinthine Drainage of the Meninges.

Indications — 1. Acute Infective Labyrinthitis occurring in the Course of Otitis Media.—The risk of meningitis in this condition is very considerable, the infection passing through the base of the modiolus along the nerve-sheaths to the subarachnoid space.

The symptoms of acute labyrinthitis are :

Initial vertigo, of sudden onset and of violent type. Objects usually are said by the patient to appear to rotate in a horizontal plane, and towards the sound side ; less commonly towards the affected side.

Headache, which may be general or basal or unilateral on the affected side.

Pain, deep-seated and severe, referred to the affected ear.

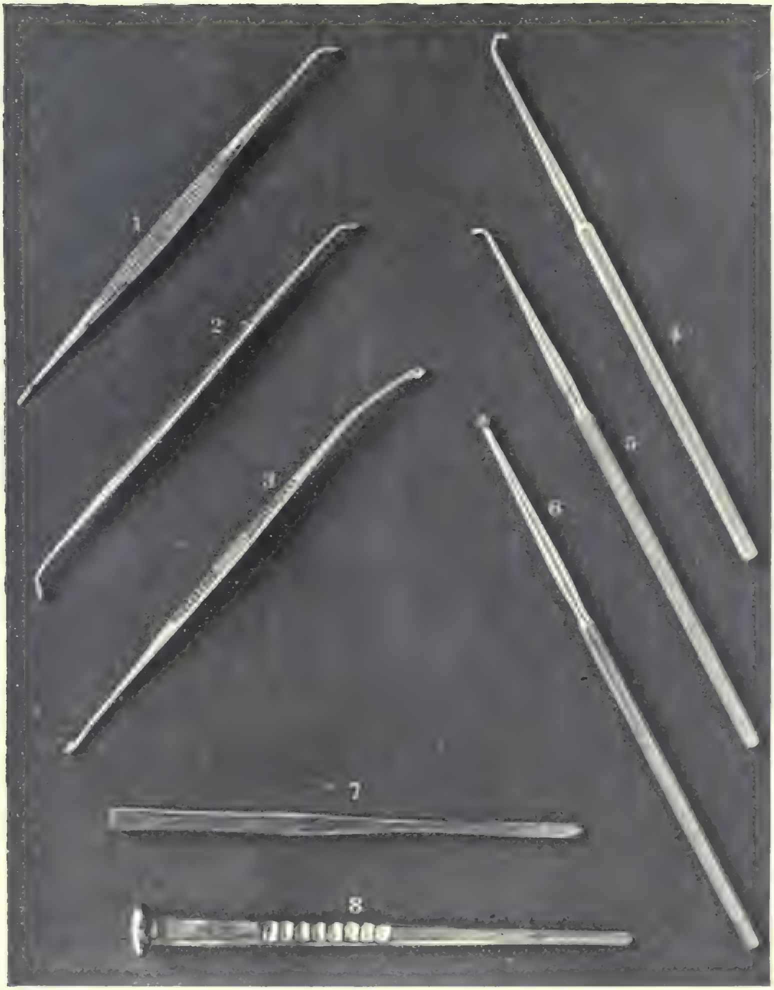
Deafness, which may be associated with loud tinnitus. When tested with the forks, there is a large loss of bone-conduction, which may be complete over a wide range of tone.

Associated with these symptoms will be the following signs :

SPECIAL INSTRUMENTS FOR OPERATIONS ON THE LABYRINTH.

1.
2. Vestibular curettes.
3.
4. Superior ampullary curette.
5. Inferior ampullary curette.
6. Small hand-burr.
7. Small chisel used to open the vestibule below the facial nerve.
8. Small gouge used to open the vestibule above the facial nerve.

Plate XII.



SPECIAL INSTRUMENTS FOR OPERATIONS ON THE LABYRINTH.

To face page 118.

Spontaneous nystagmus when the eyes are deviated from the affected side; major movement is towards the sound side. In some cases there may also be a slighter nystagmus of a combined rotatory and horizontal type on deviation to the affected side. The sensation of giddiness is increased when the eyes are directed in this way, diminished when they are turned to the affected side (see Introduction).

There may be absence of nystagmus when rotation and thermal stimuli are applied.

Inability to execute Romberg's test, the fall being towards the affected side. There may be complete inability to stand.

Alteration of gait with the eyes closed. The feet are placed uncertainly, and there is a continued alteration of direction towards the affected side. There may be complete inability to walk, with the eyes open or closed.

Vomiting. This sign may only occur in the history; it usually appears as an early sequel to the attack of vertigo, and may disappear within a few hours.

Fever—generally from 100° to 102° F.

In the history the onset of acute labyrinthitis is very sudden, and may occur without any warning whatever. In several cases which have come under our notice there has been a history of a sensation of a sudden explosive sound inside the ear, followed by immediate vertigo. Acute labyrinthitis may occur in the course of a long-standing otitis media, or within the early days of an acute otitis. The point of entrance of infection is not obvious in cases of the latter class.

2. CHRONIC INFECTIVE LABYRINTHITIS.—This condition, while of the greatest importance from its connection with meningitis of otitic origin, often exists without provoking any marked symptoms. On closer investigation, evidence of the presence of a labyrinthine fistula or of a disorganized labyrinth is probably in all cases obtainable. In a minority of cases the symptoms and signs of labyrinthine irritation are marked.

Spontaneous vertigo is the most prominent and frequent symptom. It is usually of a horizontal type, the apparent movement of objects being from the affected to the sound side. When the sensation of rotation is referred to the patient's body, there is a feeling of being turned from the sound to the affected side. In some cases, for some reason, the direction is reversed.

Vertigo is probably present at some time in all cases of infective labyrinthitis, but may be absent when the condition has become chronic. There may be a residual uncertainty of direction and of muscular co-ordination with regard to the position and movements of the feet. In cases of long standing this may only be discovered when the eyes are shut.

Paroxysmal vertigo may be severe, so that the patient falls as though seized with epilepsy. Recurrent paroxysmal vertigo in a patient with a chronic suppurating ear is very suggestive of the presence of a fistula of the external semicircular canal.

Headache is common in cases of chronic infective labyrinthitis.

Facial paralysis may occur from extension of infection to the surroundings of the facial nerve.

There may be **lateral nystagmus** on deviation of the eyes to the sound side. In children and in long-standing cases there may be complete absence of spontaneous nystagmus.

Violent **vertigo and nystagmus** on increase of the pressure on the outer wall of the labyrinth by air-pressure, or by direct pressure by probe or cotton-wool, or by forcible syringing with water at the body temperature. Abnormal response or absence of response to stimulation of the canals by heat, electrical stimulus, and rotation.

Deafness to conduction through the bone, especially for the higher notes.

Inability to execute **Romberg's test**, and insecurity of direction when walking with the eyes closed. Such movements as those of hopping, especially on one foot, are badly executed, and the disability may be more marked on the foot of the side affected.

3. THE DISCOVERY, DURING OPERATION, OF A LABYRINTHINE FISTULA which opens into the vestibule or into the ampullary part of a canal, is the most concrete of all indications for vestibulotomy, which in the latter case should be carried out above as well as below the facial nerve (Double Vestibulotomy).

4. CONTINUED OR REPEATED SEVERE ATTACKS OF VERTIGO IN A NON-SUPPURATIVE EAR, of such duration and degree that the patient is incapacitated from following his occupation, after due and patient trial has been made of medical treatment, and after the labyrinthine origin of the condition has been established.

General Preparation of the Patient.—As for the radical operation.

Local Preparation of the Patient.—As for the radical operation.

Surgeon's Outfit.—As for the radical operation; in addition, a small gouge, with a cutting edge $\frac{1}{8}$ inch broad, will be needed, and a selection of fine, sharp curettes (see description of technique and illustration).

Operative Tactics.—As for the radical operation.

Anæsthetic.—As for the radical operation.

Technique of the Operation:

STAGE 1. PERFORMANCE OF THE RADICAL OPERATION.

STAGE 2. FULL EXPOSURE OF THE INNER TYMPANIC WALL.—This is to be obtained by the complete removal of the posterior wall of the bony meatus and a part of its floor. This should be done with a gouge and mallet, cutting forwards into the meatus. Great care must be exercised to avoid injury to the descending part of the facial nerve during this part of the operation; the bone must be removed in thin layers, and the face should be vigilantly watched by an assistant.

STAGE 3. IDENTIFICATION OF THE ANATOMICAL FEATURES of the Inner Tympanic Wall.—The promontory, the pelvis ovalis, and the hooded margin of the fossula rotunda must be clearly seen. All débris and granulations or thickened mucosa must be removed by the curette.

Stage 4. Opening of the Vestibule Below the Facial Nerve.—This should be done with the small gouge or a small round-nosed chisel. It consists in the cutting away of the hooded margin of the fossula rotunda and of the bar of bone above it, which intervenes between the fossula rotunda and the pelvis ovalis, so that the outer wall of the vestibule is removed. By the subsequent use of a small curette the opening is extended slightly in a forward and downward direction, so that the cochlear opening in the floor of the vestibule is exposed, and the thin plate of bone which separates the vestibule from the fossula rotunda is broken away. Extension in a backward or upward direction is denied by the course of the facial nerve.

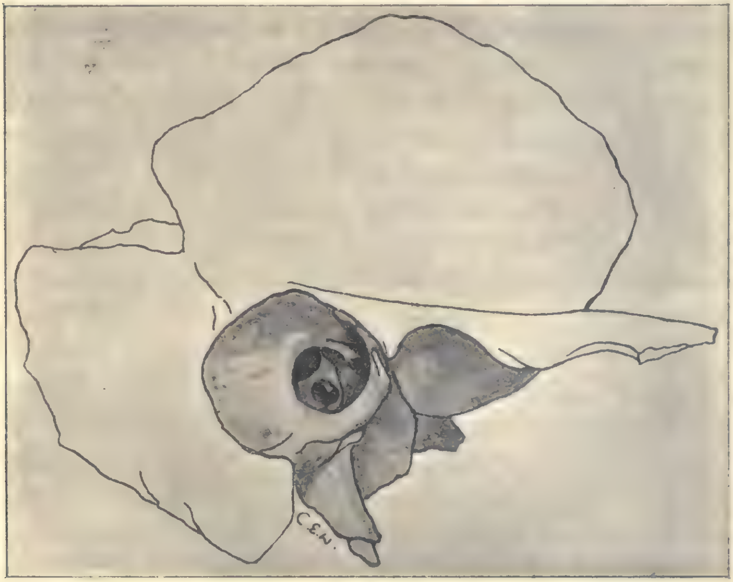


FIG. 4.—INFERIOR VESTIBULOTOMY, WITH PARTIAL REMOVAL OF COCHLEA.

STAGE 5. CURETTAGE OF THE VESTIBULAR CAVITY.—The object of this is to destroy the membranous structures within the vestibule—the utricle and saccule—and to curette away the ampullæ of the three canals and their nerve-endings, all of which are accessible through the vestibule. The vestibular curette, with its neck bent backwards to an angle of 90 degrees, is first introduced, and is carried from above downwards in the main vestibular cavity, removing the utricle and saccule. The inferior ampullary curette is next thrust into the recess behind and below, which is formed by the wide opening of the ampulla of the posterior canal, and is made to cut firmly against the floor as it is withdrawn, destroying the membranous ampulla of the posterior semicircular canal in the process. For the destruction of the nerves to the superior and external ampullæ the vestibular curette bent forwards at right angles at the neck is passed upwards through the opening in the vestibule, so that its cutting edge faces outwards and lies on the inner side of the facial aqueduct. This part of the outer wall of the vestibule is now firmly curetted. The superior ampullary curette is now introduced into the bony ampullæ of the superior and external canals, and the membranous ampullæ are destroyed.

It is not necessary to curette the antero-internal wall of the vestibule. If this is done, there is risk of injury to the very thin lamina of bone which here separates the cavity of the vestibule from the internal auditory meatus. Such injury is followed by a flow of cerebro-spinal fluid, which embarrasses the operation. The danger of infection of the meninges in this way is, however, proved by experience to be very small. (For further notes on the escape of cerebro-spinal fluid, see Translabyrinthine Drainage of the Meninges.)

STAGE 6. COMPLETION OF THE OPERATION.—The usual concho-meatal flap is cut, and the operation is terminated as an ordinary radical operation.

After-Treatment.—This is conducted on the ordinary lines of the radical operation. The first dressing is done forty-eight hours after the operation, and subsequent dressings at daily intervals. Packing is continued until cicatrization of the cavity is complete. (For further details, see the account of the Radical Operation, section After-Treatment.)

Results—1. RELIEF OF SYMPTOMS.—These, as a rule, disappear immediately and completely. The sudden cessation of vertigo, when this has been prominent, is very striking. There is often for a time a persistence of nystagmus on deviation of the eyes away from the side operated on, with the production of slight giddiness on looking in this direction.

2. HEALING OF THE OPEN LABYRINTH has in our own cases been uniformly complete. The vestibular cavity usually fills up with scar-tissue, so that the site of the opening can no longer be distinguished. There is a marked tendency to the filling up of the tympanum by fibrous tissue, which seems to be due to the extensive removal of the margo-tympanicus.

3. ULTIMATE RESULTS.—Recovery of equilibration under all ordinary conditions seems to be complete; the sense of insecurity is lost, and the patient appears in every way to have intact capabilities.* The responses to thermal stimulation of the labyrinth on the side of operation are purely negative (see Appendix).

Deafness in these cases is so great before the operation that the ear has ceased to function as a hearing organ. No useful hearing can be hoped for after vestibulotomy.

Tinnitus, which may be a troublesome symptom before the operation, is not complained of subsequently.

If the curettage of the vestibule and ampullæ is not thoroughly carried out, there may be for a time violent vertigo. This diminishes and finally disappears in from a few days to a few weeks.

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* We have, however, observed the temporary return of nystagmus, accompanied by some sensation of uncertainty, in conditions of reduced health or mental strain, at variable intervals after the operation. We have not seen this occur in children, whose recovery and loss of nystagmus is rapid and permanent.

Occasionally after operations on the labyrinth there is left for a time an ataxic condition, due to the unbalanced sensations from the opposite side. It will disappear.

Misfortunes—1. Injury to the Facial Nerve.—In inferior vestibulotomy this risk should be not appreciably greater than in the ordinary radical operation.

2. Meningitis.—In cases of chronic infective labyrinthitis the risk of meningitis cannot be ignored; it attends all operations on the tympanum under such circumstances—from simple curetting to vestibulotomy. The risk is certainly minimized by the adequate opening of the vestibule, and is probably largest in curettings of the middle ear. It need hardly be pointed out that the risk continues so long as the condition of labyrinthitis exists. Evidence accumulates that the most frequent condition antecedent to otitic meningitis is that of labyrinthitis, and that a vast proportion of the lives lost by meningitis might be saved by timely discovery and operative treatment of the antecedent condition in the labyrinth. So far we have not lost a case from meningitis following an Inferior or Double Vestibulotomy. Should meningitis occur, Translabyrinthine Drainage should be immediately carried out, combined with Lumbar Drainage. The type of meningeal infection in these cases may be mild, and we have been able to save in this way the only case which has in our hands developed meningitis after inferior vestibulotomy.

THE EXTENSION OF INFERIOR VESTIBULOTOMY TO THE PARTIAL OR COMPLETE REMOVAL OF THE COCHLEA.

Except in the case of evident and gross **disease of the cochlea**, as in tuberculous or malignant disease which has involved this part of the labyrinth, and occasionally in cholesteatoma which has eroded the promontory and invaded the cochlea, there is no need to open the main part of the promontory for the treatment of infective labyrinthitis. In cases of **acute labyrinthitis** it is probably always advisable to open the commencement of the first half-turn of the cochlea. If it has been decided to operate on the labyrinth **in a non-suppurative case**, the opening of the cochlea in part or wholly may be wise if tinnitus is a prominent feature in the symptoms; it is never necessary where the operation is done for the relief of vertigo simply.

Technique—PARTIAL REMOVAL.—This is simple, and requires no additional instruments. The operation of inferior vestibulotomy having been completed as far as the opening of the vestibule, the lumen of the first half-turn of the cochlea is opened by cutting away the lower part of the promontory with the small gouge and the hammer, working forwards from the open vestibule.

COMPLETE REMOVAL.—To completely remove the cochlea is no easy task, the most remote portion—the anterior half of the first turn—lying very awkwardly, with the knee of the carotid canal immediately below it, while access is hindered by the anterior wall of the bony meatus. In addition, a low conical recess of the fundus of the internal auditory meatus so hollows the internal aspect of the base of the modiolus that the fundus must almost necessarily be opened in getting at the anterior half of the basal turn.

A start is made by opening the first half-turn in the way just described. The remainder of the operation is most conveniently carried out by means of a power-driven burr, which is made to hollow out the shell of the cochlea, breaking down the internal partitions between the turns—the lamina spiralis and the modiolus. As the size of the cavity increases, successively larger burrs should be used, so that the tool in use always fills the major part of the cavity. Unless this precaution is taken, there is a greatly added risk of plunging through into the carotid canal. On the destruction of the basal part of the modiolus, there is inevitably a free escape of cerebro-spinal fluid, which may cause some inconvenience, but need excite no alarm. The axis of the modiolus lies in a direction outwards and forwards, and a little downwards, and the apex of the cochlea lies against the inner wall of the commencement of the Eustachian tube, on a level with the musculo-tubal crest.

In the majority of cases it will be found that much better exposure of the promontory is attained by removal of the anterior wall of the bony meatus. To do this the periosteum of its anterior surface is separated and pushed forwards by a thin elevator, carrying in front of it the tissues which lie behind the neck of the lower jaw. The bone is then clipped away by nibbling forceps down to the level of the margo-tympanicus, and the soft structures in front are held forwards by a narrow retractor. By this means a very direct access to the anterior part of the inner tympanic wall is obtained. This removal is absolutely needed if the destruction of the cochlea is being effected with the gouge and mallet.

After-Treatment is carried out on exactly the same lines as in a case of the radical mastoid operation, but during the first few days the escape of cerebro-spinal fluid may make frequent dressing necessary. The plugging should be changed at least once a day while there is any escape, and the dressing must be carried out under rigid aseptic conditions. As a rule, leakage from the meninges ceases within two to four days, and from this point there is nothing in the after-treatment to distinguish these cases from those which have undergone a standard Radical Operation.

DOUBLE VESTIBULOTOMY.

In Double Vestibulotomy the vestibule is opened both above and below the facial aqueduct. Its object is to secure drainage of the vestibule and to allow destruction of the ampullary nerve-endings. It is used instead of Inferior Vestibulotomy for these purposes when there is a fistula into the ampullary end of the external or superior semicircular canal, or through the roof of the vestibule. In these cases experience has shown that inferior vestibulotomy must be added to a simple opening of the upper part of the outer wall of the vestibule by the enlargement of the fistula, or there is inadequate drainage of the labyrinth and serious risk of meningitis.

Indications.—The indications for double vestibulotomy are the same as those for inferior vestibulotomy, with the addition that there is a fistulous track leading into the vestibule through its roof or through the ampullary end of a canal. Fistulæ of the external canal posterior to the ampulla, without symptoms of active labyrinthine irritation, do not call for more than the thorough scraping of their edges, unless a sequestrum can be felt through the fistula.

For detailed treatment of the indications, see Inferior Vestibulotomy.

General Preparation of the Patient.—As for the Radical Operation.

Local Preparation of the Patient.—As for the Radical Operation.

Surgeon's Outfit.—As for Inferior Vestibulotomy.

Operative Tactics.—As for the Radical Operation.

Anæsthetic.—As for the Radical Operation.

Technique of the Operation:

STAGE 1. PERFORMANCE OF THE RADICAL OPERATION.

STAGE 2. IDENTIFICATION OF A FISTULA OF THE REGION OF THE AMPULLÆ OF THE EXTERNAL AND SUPERIOR CANALS, OR OF THE ROOF OF THE VESTIBULE.

STAGE 3. OPENING OF THE VESTIBULE ABOVE THE FACIAL NERVE BY THE ENLARGEMENT OF THE FISTULA AND REMOVAL OF THE ROOF OF THE VESTIBULE.—This constitutes the discarded operation of Superior Vestibulotomy. The small gouge should be used and worked from behind forwards along the line of the external arcuate eminence until the ampulla of the external canal is laid open. By the removal of bone above and slightly in front of the external ampulla, the ampulla of the superior canal will be opened. The wedge-shaped small mass of bone remaining between the two opened ampullæ on their inner side is now cut away by the cautious use of the gouge or of a narrow round-nosed chisel, so completing the removal of the roof of the vestibule. The position of the tympanic part of the facial aqueduct must be remembered, particularly during the early stage before the lumen of the external canal is available as a guide; while in the opening of the ampulla of the superior canal it is possible to drive the tool too far forwards and sever the facial nerve at or close to its genu.

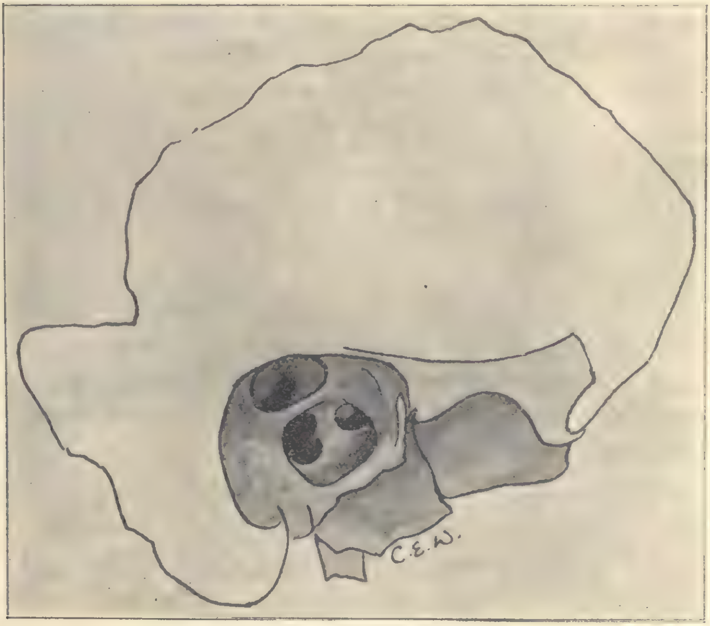


FIG. 5.—DOUBLE VESTIBULOTOMY.

STAGE 4. FULL EXPOSURE OF THE INNER TYMPANIC WALL, as described in Stage 2 of Inferior Vestibulotomy.

STAGE 5. IDENTIFICATION OF THE ANATOMICAL FEATURES OF THE INNER TYMPANIC WALL, as described in Stage 3 of Inferior Vestibulotomy.

STAGE 6. OPENING OF THE VESTIBULE BELOW THE FACIAL NERVE, as described in Stage 4 of Inferior Vestibulotomy. This completes the double operative opening of the vestibule.

STAGE 7. CURETTAGE OF THE VESTIBULAR CAVITY, as described in Stage 5 of Inferior Vestibulotomy. Great care must be exercised to avoid fracture of the bar of bone which supports the facial nerve and spans the interval between the upper and lower openings into the vestibule. The ampullary nerves to the external and superior canals may also be curetted from above through the upper opening.

STAGE 8. COMPLETION OF THE OPERATION.—The usual concho-meatal flap is cut, and the operation is terminated as an ordinary radical operation.

After-Treatment.—This differs in no way from that of a simple Inferior Vestibulotomy (*q.v.*).

Results.—These are excellent in properly selected cases. The cavity of the vestibule becomes obliterated by scar, and healing is completed in the average time of a Radical Operation. The symptoms when present are uniformly relieved. (See further under this heading in Inferior Vestibulotomy.)

Misfortunes.—The risks attending operation on a chronic suppurating labyrinth have been explained under this heading in Inferior Vestibulotomy. In Double Vestibulotomy the facial nerve runs more risk than in the operation of Inferior Vestibulotomy, as it is left isolated in a narrow bridge of brittle bone between the upper and the lower openings. Even when this fractures, however, the nerve does not necessarily suffer any damage, even of a temporary nature. Under such circumstances it is particularly necessary that the plugging should be done lightly, in order to avoid direct pressure on the exposed nerve.

CHAPTER XII

THE OPERATIONS FOR MENINGITIS

TRANSLABYRINTHINE DRAINAGE OF THE BASAL MENINGES.

THE aim of this operation is to procure drainage of the basal meninges in cases of their infection by extension from the middle ear. Investigation has shown that the usual route of this extension of infection is through the labyrinth and the internal auditory meatus. The internal meatus encloses a prolongation of the arachnoid membrane and of the subarachnoid space, the latter taking the form of a tubular diverticulum from the cisterna pontis along the seventh and eighth nerves as they pass to the fundus of the internal meatus. Close to the commencement of this passage lie the tip of the cornucopia of the fourth ventricle, which passes outwards over the restiform body, and the deepest part of the sloping anterior border of the cerebellum. Once the infection has reached the canal of the internal meatus, there is already established a local leptomeningitis. To remove the primary focus from which infection has spread, and to drain the area of the meninges which is earliest involved, is on these grounds anatomically reasonable, and is at the same time of demonstrated efficiency.

The type of meningitis which is likely to benefit is that known as "meningitis serosa," rather than a plastic form. In the earlier stages of such cases the watery exudate is only turbid. Death is caused by pressure, which brings about paralysis of the respiratory centre. If the pressure is relieved and its recurrence prevented, it would seem that the leptomeninges, like the peritoneum, are capable of dealing with a considerable mass of infection, if this is not too virulent nor too widespread. In some cases at least the area of infection is limited to the arachnoid sheath of the seventh and eighth nerves, so that an almost globose distended sac is formed immediately to the inner side of the opening of the internal auditory meatus.

In otitic meningitis the one hope lies in such free drainage of the cerebro-spinal meninges that, by the continued flow of cerebro-spinal fluid and its replacement by the secretion of the choroid plexuses, the whole infected area may be subjected to a process of auto-irrigation. To this end all available ways of drainage—through the internal meatus, from the basal cisterns, by cannula from the lumbar theca, and from the lateral ventricle—may with advantage be utilized. Such vigorous methods promise to be of considerable value in the less virulent forms of meningitis. In the fulminating cases, in which the symptoms are mainly toxic, there is small hope of any measures at present available being of any use.

Indications.—Translabyrinthine drainage will be indicated as a part of the procedure in cases in which the patient has the following symptoms:

Elevation of temperature. Headache. Vomiting.

Stiffness of the muscles of the back of the neck, and, in fully developed cases, retraction of the head.

The patient, as a rule, lies quietly on one side, with the eyes closed and the arms and legs flexed, and is only fretful or noisy when disturbed. The head may be moderately retracted. In children there may be opisthotonos. The knee-jerks are often absent; the plantar reflex is uncertain. There may be a strongly marked tâche cérébrale.

On lumbar puncture a fluid is obtained which is not perfectly clear, showing after centrifugalization a preponderance of polymorphonuclear leucocytes on a cytological count, and possibly organisms in films of the centrifugalized deposit. In some cases the demonstration of organisms may be only possible by culture; in some, cultures remain sterile.

The blood-count shows in favourable cases only a moderate leucocytosis of about 12,000 to 15,000 per cubic millimetre.

General and Local Preparation.—When necessary and practicable, these will be carried out on the usual lines as for a radical operation.

Anæsthetic.—As for the Radical Operation.

Operative Tactics.—As for the Radical Operation.

Surgeon's Outfit.—As for Inferior Vestibulotomy; in addition, there will be required a piece of silver or pewter wire about 4 inches long. This is to be doubled, and then twisted upon itself from the loop towards the free ends for about 1 inch, the ends being then bent out and returned upon themselves in a loop so as to form a **Y**-shaped figure (see Illustration).

Technique:

STAGE 1. PERFORMANCE OF THE RADICAL OPERATION, if this has not already been done.

STAGE 2. PERFORMANCE OF INFERIOR VESTIBULOTOMY.

STAGE 3. OPENING OF THE INTERNAL AUDITORY MEATUS THROUGH THE INNER WALL OF THE VESTIBULE.—This is most simply performed by means of a small but strongly made spoon-curette, the head of which is bent slightly backwards. It is introduced into the cavity of the vestibule, and pushed firmly against its inner wall, so as to break through it in the region of the foveæ. The bone will be felt to give way, and an immediate flow of cerebrospinal fluid will follow, welling up copiously into the tympanum. The edges of the opening in the vestibular wall are now broken down by the spoon in front and below, but not upwards. In this way the facial nerve is avoided. After the release of the fluid from the basal meninges, the patient's general condition and respiration should improve if there has been any cause for anxiety from the effects of intracranial pressure.

The twisted wire is now taken, and is introduced, through the openings in the outer and inner walls of the vestibule, into the internal auditory meatus, the side-arms being arranged so as to lie easily within the operation cavity.

STAGE 4. COMPLETION OF THE OPERATION.—A rather large concho-meatal flap is cut in the usual way, and is stitched by one or more catgut sutures to the edge of the temporal fascia, as the wound must be packed from behind in the early stages of the operation.

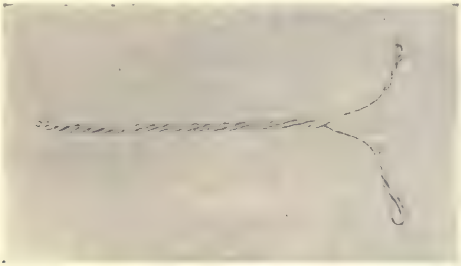


FIG. 6.—WIRE DRAIN FOR TRANSLABYRINTHINE DRAINAGE OF MENINGES.

The whole cavity is lightly filled with gauze plugging through the post-aural wound, which is left open.

A large gauze and wool dressing is applied, and secured by the usual bandage.

After-Treatment.—The escape of cerebro-spinal fluid is likely to be copious during the first twenty-four hours, and the outer dressing must be renewed as often as is necessary.

After twenty-four hours the first complete dressing is carried out, care being taken not to withdraw the wire-drain with the plugging. The cavity is gently irrigated with 1 in 4,000 biniodide lotion. The wire-drain is now withdrawn for about ½ inch, turned to and fro through a half-circle, and replaced in its original position. The object of this manœuvre is to release the wire from any plastic lymph which may have been deposited round it and interfere with the freedom of the drainage. The cavity is finally refilled with plugging, and a fresh dressing is applied. If treated in this way, there is no difficulty in keeping the opening as an active drain for four days if necessary. As soon as the temperature has been normal for thirty-six hours, the wire may be finally withdrawn. If it should become accidentally displaced during a dressing, it must be reinserted.

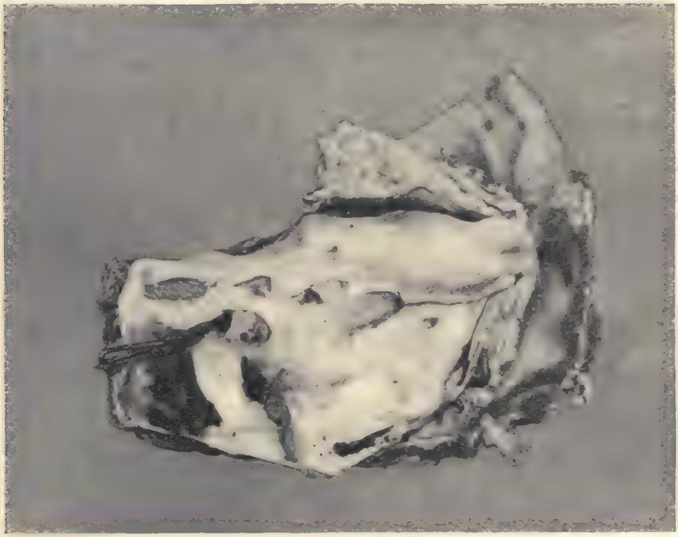


FIG. 7.—POSTERIOR ASPECT OF RIGHT PETROUS, REMOVED POST-MORTEM FROM A CASE OF MENINGITIS TREATED BY TRANSLABYRINTHINE DRAINAGE, SHOWING WIRE - DRAIN IN SITU PROJECTING FROM THE INTERNAL AUDITORY MEATUS.

Results.—It is as yet too early to speak with certainty on the prospect which this operation holds out of saving the less virulent cases of meningitis. We can only say that we have by its use, combined with lumbar drainage, succeeded where previous experience with cases of similar type led us to expect a fatal result, and that we regard it as a method of great promise. It has two obvious advantages over post-labyrinthine drainage (*vide infra*)—that the route of infection is strictly followed, and that the internal meatus affords a natural drainage-tube, which is infallibly rightly placed, and leads directly to the part of the subarachnoid space which it is desired to reach. In addition, there is the great gain that the primary source of meningeal infection is removed.

Misfortunes.—The only added risk of this operation over those of an inferior vestibulotomy is that of infection through the open internal meatus. If our contention of the labyrinthine origin of otitic meningitis is correct, and the diagnosis of meningitis is a true one, this risk must be less than that due to the continued presence of an infected and unopened labyrinth. Judging from the number of cases in which we have seen the escape of cerebro-spinal fluid in operations on the labyrinth and the complete freedom which these patients have had from any ill-effects, the risk must in any circumstances be a small one.

If the opening is made in the manner advised, there should be no injury to the facial nerve from this part of the operation.

POSTLABYRINTHINE DRAINAGE OF BASAL MENINGES.

This operation is designed to drain the cisterna pontis through an incision in the dura mater of the posterior fossa in cases of meningitis of the base. It is an alternative to the "translabyrinthine" operation, or may be employed as an accessory measure along with this.

Indications.—These are dealt with under the operations of Lumbar Drainage and Translabyrinthine Drainage of the Meninges (*q.v.*). A preliminary lumbar puncture should in all cases be made for diagnostic purposes, and a cytological count made of the centrifugalized fluid. It is not, as a rule, wise to wait for twenty-four hours for a cultural investigation, and the cultures may remain sterile, even where the fluid is distinctly turbid, infection not yet having travelled to the farther parts of the meninges.

General Preparation of the Patient.—No general preparation will, as a rule, be needed, except an enema, which should be given an hour before the time fixed for the operation. When the diagnosis is made, the operation should be carried out with as little delay as possible.

Local Preparation.—As there has in many cases been a recent operation on the mastoid, either as a routine case or for the relief of the symptoms before their full development, it will, as a rule, be best to leave the dressings undisturbed until the patient is under an anæsthetic. Where the operation is a primary one it will be well, in view of the length of the operation, to shave the mastoid area, and to go through the routine preparatory dressing if the patient's condition allows of it.

Surgeon's Outfit.—As for the radical mastoid operation. A fine drainage-tube will be required.

Operative Tactics.—As in the performance of the radical operation.

Anæsthetic.—Chloroform anæsthesia should be cautiously induced, and all excess of dose most carefully avoided.

Technique of the Operation:

STAGE 1. PERFORMANCE OF THE RADICAL OPERATION, where this has not already been done. A careful examination should be made of the outer wall of the labyrinth.

STAGE 2. REMOVAL OF THE INNER WALL OF THE ANTRUM, AND OF THE EXTERNAL AND POSTERIOR SEMICIRCULAR CANALS.—To do this the dura mater of the posterior fossa is first exposed in the outer part of the cavity, and the inner border of the lateral sinus is recognized. The dura mater is now followed inwards along the posterior surface of the petrous, the bone being cut away in a direction directly inwards, and the surface of the dura mater protected by passing the flat dural elevator between it and the bone. In this way the whole of the wedge of bone included between the posterior and upper surfaces of the petrous is taken away, as far forwards as the anterior limit of the antrum, and nearly up to the entrance of the internal auditory meatus. In doing so the posterior and the main part of the external canals are removed as constituents of a mass of bone which must be got rid of to afford approach to the dura mater covering the deeper part of the posterior surface of the petrous.

Stage 3. Incision of the Dura Mater—Opening of the Cisterna Pontis.—The exposure of the dura mater of the posterior fossa obtained is triangular, the lower border sloping upwards and inwards. The incision should be made from without inwards close to this border with the tenotome; it should be ¾ inch long, and should end at the deepest part of the exposed area. Care must be taken to avoid deep penetration by the point of the knife. There will probably be an immediate escape of cerebro-spinal fluid. A director is now passed gently inwards through the deepest part of the opening in the dura mater, the point being kept close to the bone, and the direction being directly inwards, and not following the forward trend of the posterior surface of the petrous. When the point has passed about ½ inch inwards, a sudden gush of fluid will mark the penetration of the distended cistern. A second director or a probe is passed alongside of the first, and their points separated in a horizontal direction for about ½ inch to tear a larger hole in the arachnoid. Both are then retained in position by the assistant, and the surgeon passes a small rubber tube inwards between them. The tube is cut off so that its outer end lies just outside the mastoid cavity, and is fixed by a suture to the margin of the wound. There should be no lateral openings to the tube, and its inner end should be cut off at right angles, not obliquely.

Stage 4. Completion of the Operation.—The post-aural wound is left open and the whole cavity is lightly filled with gauze plugging. A plentiful gauze and wool dressing is needed, and the side of the neck should also be covered in with wool. The bandage should be taken round the head and neck in figure-of-eight form, crossing over the main part of the dressing.

After-Treatment.—The first dressing should be not later than twenty-four hours after the operation, and earlier if the dressings become soaked. The plugging is cautiously removed, care being taken to avoid pulling the tube out of the opening in the dura mater. The cavity is irrigated and dried out. A probe is now passed along the lumen of the tube, to insure its freedom, and also along each side of it. The cavity is again filled with gauze, and the outside dressing is renewed. This procedure must be repeated as often as the dressing becomes soaked, and at least once in every twenty-four hours. If the fluid ceases to flow along the tube in spite of the use of the probe, it can only serve as a possible route for further infection, and had better be withdrawn. The difficulty of maintaining drainage through this path is its chief disadvantage, and in this respect the operation is undoubtedly inferior to the translabyrinthine drainage of the basal meninges.

Results.—We have come to the conclusion that the translabyrinthine operation is on several grounds the better. The path of infection in otitic meningitis has been established by one of us, as a result of microscopical research, to be in an unsuspected number of cases through the labyrinth. Unless this cavity is opened up, we must expect a continued ingress of fresh numbers of organisms to the meninges. In the translabyrinthine operation a vestibulotomy is an integral part of the method, and the primary focus of infection is thus removed. The internal auditory meatus forms a natural drainage-tube, leading directly to the infected area. If desired, the postlabyrinthine operation may be combined with the translabyrinthine and with puncture of the lateral ventricle. We have described the operation as one of the methods which we have found of some promise in the surgical treatment of meningitis, and in the hope that other hands may be able to improve on its efficiency.

For a résumé of cases illustrating the connection between labyrinthine infection and meningitis, see Appendix.

CHAPTER XIII

LUMBAR PUNCTURE—LUMBAR DRAINAGE

By lumbar puncture is meant the tapping of the spinal theca in the lumbar region. By lumbar drainage is meant the maintenance of a free exit for cerebro-spinal fluid from the lumbar part of the theca.

Indications—1. Lumbar Puncture.—The most frequent use of this operation in aural surgery is to withdraw fluid for examination, bacteriological and cytological, in cases of suspected intracranial extension from infective processes within the ear. It may also be used as a temporary measure of relief in cases of severe intracranial compression, until a larger operation can be carried out. It is sometimes a wise preliminary to exploratory operations on the brain where the breathing gives rise to fear in the employment of an anæsthetic.

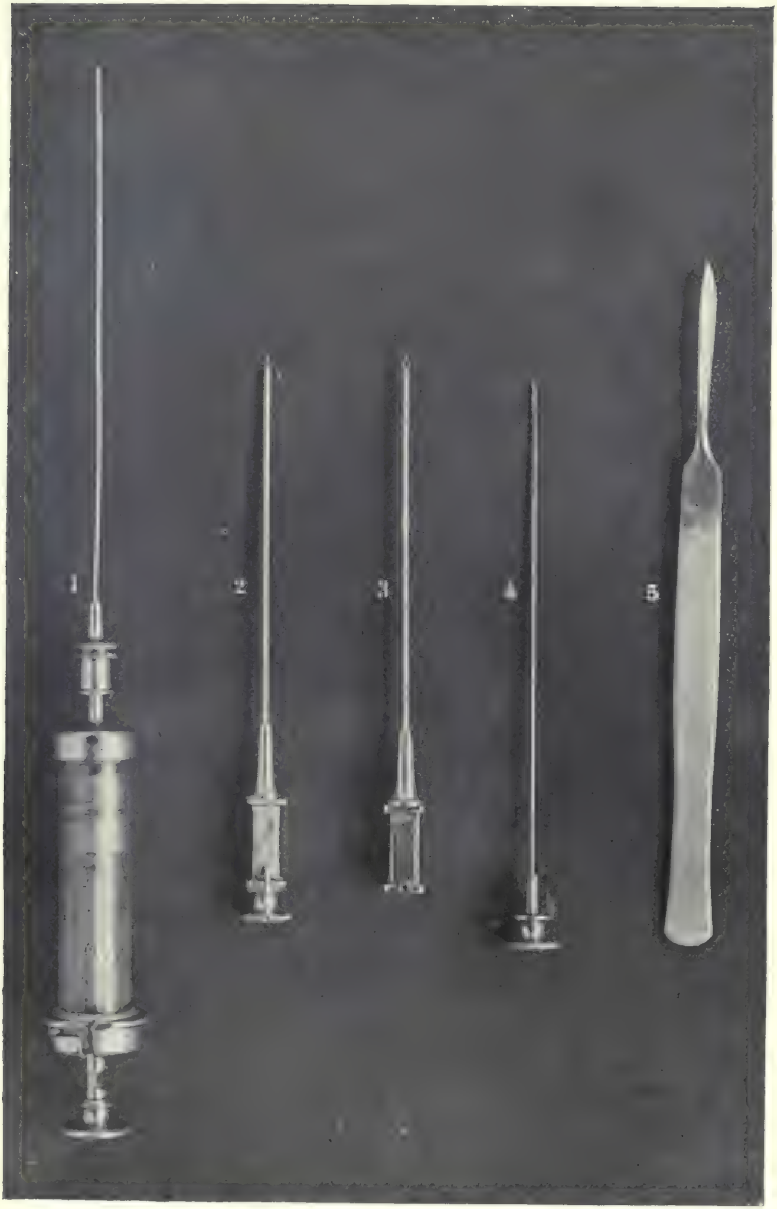
2. Lumbar Drainage.—This operation is indicated in all cases of meningitis of aural origin. It is of special value where the fluid withdrawn is plentiful and only slightly turbid, and, bacteriologically investigated, shows only organisms of low virulence. In such cases drainage may give surprisingly good results, provided always that the original focus of infection has been removed.

General Preparation of the Patient.—The period of anæsthesia required for either operation is a short one; indeed, in young children lumbar puncture can be easily performed without a general anæsthetic. If a general

INSTRUMENTS FOR LUMBAR PUNCTURE.

1. Fine hollow needle fitted to Record Syringe for aspiration.
2. Hollow needle fitted with obturator, which insures the lumen of the needle being free.
3. Hollow needle, and
4. Obturator separated from the needle, to show the form of their points.
5. Sharp-pointed tenotome.

Plate XIII.



INSTRUMENTS FOR LUMBAR PUNCTURE.

To face page 142.

anæsthetic is to be administered, the patient should, where possible, be prepared on the usual lines.

Local Preparation.—The back below the level of the twelfth dorsal spine is thoroughly washed with soap and water applied with a brush; it is then rubbed with ether, washed over with spirit lotion, and, if the preparation is not being done under the anæsthetic, or is not to be followed immediately by the operation, is finally washed over with 1 in 4,000 biniodide lotion, and a dressing applied.

Surgeon's Outfit.—1. FOR PUNCTURE ONLY:

A fine trocar and cannula of good length (see Plate XIII.).
Fine-bladed sharp-pointed tenotome.
Sterilized test-tubes, plugged with sterile wool.
Culture-tubes, agar-agar, nasgar, and peptone broth. (A blood-agar tube may be useful.)
A platinum-wire loop.
Spirit-lamp.
Dissecting forceps.
Sterile gauze.
Collodion.
Rubber gloves.
Apron.
Towels.

The length of the cannula must correspond to the depth of the theca from the surface if drainage is to be carried out; it must not come into contact with the front of the theca, and must not project from the surface more than $\frac{1}{8}$ inch.

2. FOR DRAINAGE.—There will also be required:

A sterilized piece of Keith's rubber sheeting, 2 feet square.
Sterilized wool and gauze.
A many-tailed bandage, the pieces of which should not be sewn together in any way.

Anæsthetic.—It matters little what anæsthetic is given for either of these operations. Gas and ether, chloroform, or the A.C.E. mixture in children, may be given at the choice of the administrator.

Operative Tactics.—The surgeon stands at the right-hand side of the table, his assistant opposite him, the anæsthetist at the head of the table. At the surgeon's right hand is a table for the instruments and culture-tubes.

Lumbar Puncture: Technique of the Operation.—The patient is placed in the semiprone position, turned to the left, with the left leg straightened and the right flexed at the knee. The left arm is brought out to the back of the patient. Towels are spread at each end and at each side of the lumbar spine. The surgeon now identifies the spinous process at the level of the highest point of the iliac crest (fourth lumbar), and places the tip of the forefinger of the left hand immediately to its left side, the nail pointing towards the sacrum and on a level with the lower border of the process. The trocar and cannula (see Plate XIII., Fig. 2) is now pushed in at a point ½ inch from the middle line and immediately below the guiding finger-nail. The direction should be almost directly forwards, with a very slight inclination upwards and inwards. If this method is followed, the interval between the laminæ of the fourth and fifth lumbar vertebræ is hit off without the edges of the bone being felt. The resistance of the dense ligamentum subflavum is distinctly felt, and immediately this is passed the theca is entered. The trocar is quickly withdrawn, and the issuing fluid is received in a sterile tube, handed to the operator by the assistant. The flow is allowed to continue until it becomes a slow series of drops. The cannula is then withdrawn, and the puncture is sealed with a pad of gauze soaked in collodion.

Cultures should be made immediately on the termination of the operation, and the remainder of the fluid reserved for centrifugalization, and the making of a cytological and bacteriological examination.

No special after-treatment is required by the operation itself. The patient should be kept in bed for twenty-four to forty-eight hours. The adherent gauze pad will drop off in about a week.

Lumbar Drainage: Technique of the Operation—STAGE 1.—The cannula is introduced in exactly the same way as has been described under Lumbar Puncture, and the fluid is allowed to run till the escape is reduced to a series of drops.

STAGE 2.—A very small hole is cut in the centre of the Keith's sheet with scissors, and is stretched over the head of the cannula. The sheet is then spread out flat, and a pad of loosely-heaped sterilized gauze laid over the top of the cannula. Over this is placed a thick pad of sterile wool 6 inches square. The upper and lower edges of the sheet are next folded in over the pad, and the ends rolled inwards. A large pad of wool is placed over the dressing, and the many-tailed bandage is applied so as to firmly fix the whole.

The fluid should be cultivated from and examined in the same way as after lumbar puncture.

After-Treatment.—The first dressing will be required in about twelve hours. The operation area is carefully isolated by sterilized towels after removing the bandage, but before disturbing any part of the dressing. The rubber sheet is unfolded and spread out flat, and the wool and gauze which were inside it are removed. The quantity of fluid which will have escaped is large, and can be roughly estimated by squeezing out the pads. A fresh dressing exactly like the original one is applied, the rubber sheet refolded, and the bandage replaced. The most minute care must be taken to insure aseptic conditions in the dressing, and gloves must be worn. Subsequent dressings must be made as often as is requisite.

The drain of fluid is very severe, and, indeed, the efficiency of the method depends on the constant irrigation of the meninges in this way. From the first the patient's intake

Anæsthetic.—It matters little what anæsthetic is given for either of these operations. Gas and ether, chloroform, or the A.C.E. mixture in children, may be given at the choice of the administrator.

Operative Tactics.—The surgeon stands at the right-hand side of the table, his assistant opposite him, the anæsthetist at the head of the table. At the surgeon's right hand is a table for the instruments and culture-tubes.

Lumbar Puncture: Technique of the Operation.—The patient is placed in the semiprone position, turned to the left, with the left leg straightened and the right flexed at the knee. The left arm is brought out to the back of the patient. Towels are spread at each end and at each side of the lumbar spine. The surgeon now identifies the spinous process at the level of the highest point of the iliac crest (fourth lumbar), and places the tip of the forefinger of the left hand immediately to its left side, the nail pointing towards the sacrum and on a level with the lower border of the process. The trocar and cannula (see Plate XIII., Fig. 2) is now pushed in at a point ½ inch from the middle line and immediately below the guiding finger-nail. The direction should be almost directly forwards, with a very slight inclination upwards and inwards. If this method is followed, the interval between the laminæ of the fourth and fifth lumbar vertebræ is hit off without the edges of the bone being felt. The resistance of the dense ligamentum subflavum is distinctly felt, and immediately this is passed the theca is entered. The trocar is quickly withdrawn, and the issuing fluid is received in a sterile tube, handed to the operator by the assistant. The flow is allowed to continue until it becomes a slow series of drops. The cannula is then withdrawn, and the puncture is sealed with a pad of gauze soaked in collodion.

Cultures should be made immediately on the termination of the operation, and the remainder of the fluid reserved for centrifugalization, and the making of a cytological and bacteriological examination.

No special after-treatment is required by the operation itself. The patient should be kept in bed for twenty-four to forty-eight hours. The adherent gauze pad will drop off in about a week.

Lumbar Drainage: Technique of the Operation—STAGE I.—The cannula is introduced in exactly the same way as has been described under Lumbar Puncture, and the fluid is allowed to run till the escape is reduced to a series of drops.

STAGE 2.—A very small hole is cut in the centre of the Keith's sheet with scissors, and is stretched over the head of the cannula. The sheet is then spread out flat, and a pad of loosely-heaped sterilized gauze laid over the top of the cannula. Over this is placed a thick pad of sterile wool 6 inches square. The upper and lower edges of the sheet are next folded in over the pad, and the ends rolled inwards. A large pad of wool is placed over the dressing, and the many-tailed bandage is applied so as to firmly fix the whole.

The fluid should be cultivated from and examined in the same way as after lumbar puncture.

After-Treatment.—The first dressing will be required in about twelve hours. The operation area is carefully isolated by sterilized towels after removing the bandage, but before disturbing any part of the dressing. The rubber sheet is unfolded and spread out flat, and the wool and gauze which were inside it are removed. The quantity of fluid which will have escaped is large, and can be roughly estimated by squeezing out the pads. A fresh dressing exactly like the original one is applied, the rubber sheet refolded, and the bandage replaced. The most minute care must be taken to insure aseptic conditions in the dressing, and gloves must be worn. Subsequent dressings must be made as often as is requisite.

The drain of fluid is very severe, and, indeed, the efficiency of the method depends on the constant irrigation of the meninges in this way. From the first the patient's intake of fluid must be kept large; free administration of fluid by the mouth and rectal injections should be utilized, and, if necessary, infiltration into the cellular tissue. The condition of the patient must be carefully watched, as rapid collapse may occur from loss of fluid. If this takes place, the escape must be at all events temporarily arrested by plugging the opening of the cannula. Unless the patient's condition makes it necessary, the cannula should not be withdrawn until the temperature has remained normal for thirty-six hours.

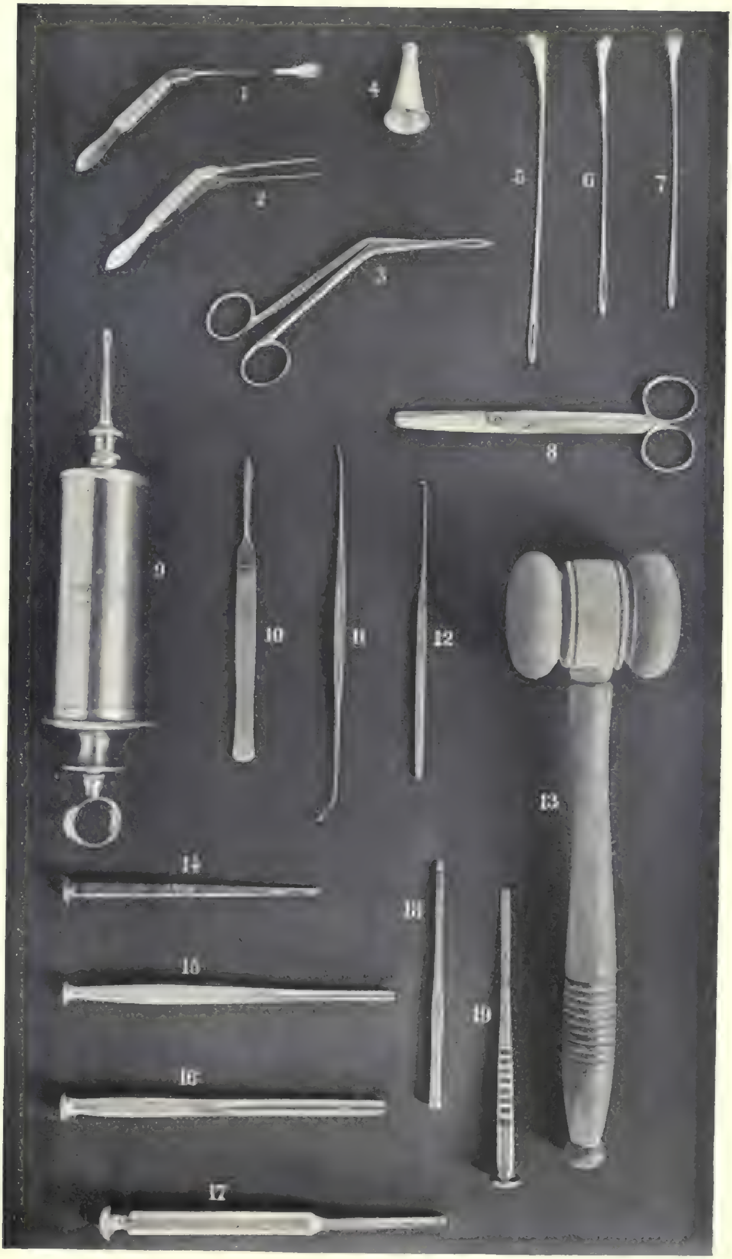
Results.—If the original focus of infection has been removed—in many cases an infected labyrinth—we believe that this procedure, combined with Translabyrinthine Drainage (*q.v.*), offers a good chance of saving the less virulently infected cases of meningitis. In the worst cases, where there is but little fluid, and the exudate is plastic or of thick creamy consistence, the chance of doing any good must always be very small. The prospect is best in cases of infection from the labyrinth in an early stage.

Misfortunes.—With proper care the risks of lumbar puncture are negligible. In lumbar drainage, on the other hand, the most scrupulous care must be maintained throughout to avoid the risk of infection through the cannula. The danger is one of after-treatment rather than a primarily operative one.

INSTRUMENTS FOR THE REMOVAL OF A MEATAL EXOSTOSIS.

1. Aural forceps used as wool carrier.
2. Aural forceps.
3. Small Hartmann's forceps.
4. Aural speculum.
5. }
6. } Wool-carrying probes.
7. }
8. Scissors.
9. Syringe.
10. Sharp-pointed tenotome.
11. Fine steel elevator.
12. Blunt hook.
13. Wooden mallet.
14. }
15. } Gouges.
16. }
17. }
18. } Chisels.
19. }

Plate XIV.



INSTRUMENTS FOR THE REMOVAL OF A MEATAL EXOSTOSIS.

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CHAPTER XIV

THE OPERATIONS FOR MEATAL EXOSTOSIS

THE object of the operations is the restoration of the lumen of the meatus.

Indications.—By no means all exostoses call for operation. Hearing may be maintained very satisfactorily through a mere cleft if this can be kept open. The enlargement of the meatus is definitely indicated when—

Occlusion is so far advanced that the cleft is quickly filled by cerumen or epithelial débris, and its clearance becomes a matter of difficulty and constantly recurring trouble.

The exostosis has so grown as to exert pressure on the opposite wall of the meatus, producing pain and ulceration.

The exostosis is associated with a purulent discharge, the adequate treatment of which it renders impossible.

Exostoses of the meatus are of two classes:

1. The **cancellous**, which may be merely the result of the ossification of a mass of granulation which has its origin in the meatal periosteum. During the period of growth they are associated with a purulent discharge, and the ossification is often very incomplete. Like the granulations from which they originate, they tend to assume a pedunculated form. Their most common point of attachment is the postero-superior part of the margo-tympanicus.

2. The **compact**, of unknown causation, occurring chiefly in elderly men. These grow very slowly, are of hemispherical outline, and are intimately continuous with the tympanic

plate from which they grow. They are most common on the posterior wall of the meatus, but are not infrequently double, a second growing from the anterior wall, so that the two meet in the middle of the meatus. It may suffice in such cases to remove the larger of the two exostoses.

Surgeon's Outfit: 1. FOR THE REMOVAL OF A CANCELLOUS EXOSTOSIS.—If the exostosis is of the cancellous variety, and accompanied by suppurative otitis media, it will often be best to perform a radical operation, and remove the exostosis as an incident in the operation (see under the account of the Radical Mastoid Operation). If it is decided to remove the exostosis without other interference, the instruments and appliances required will be the same as for the removal of a compact exostosis (*vide infra*), as, though in the majority of cases nothing more than a small strong spoon will be used, the operator must always be prepared to undertake a much more extensive operation if such be found necessary.

2. FOR THE REMOVAL OF A COMPACT EXOSTOSIS.—A selection of three or four gouges of varying sizes, from 3 millimetres to 7 millimetres. They should be sharpened from the hollow side, so as to cut when laid at only a slight angle with the surface.

A small chisel of the special form illustrated.
A light and well-balanced hammer (a wood-carver's wooden mallet is very suitable).
Fine steel elevator.
Syringe.
Wool-carrying probes for swabbing out the meatus.
Small Hartmann's forceps.
Head-lamp.
Aural specula.
Aural forceps.

And, in addition, the full set of instruments for the radical operation. Towels, bowls, lotions, instrument-trays, as usual.

Preparation of the Patient.—The general preparation of the patient is as for any other prolonged operation. Should the surgeon intend to perform the operation, if possible, through the meatus, no local preparation will be required beyond cleansing of the pinna and meatus. If a post-meatal operation is contemplated, an area similar to that for the radical operation should be shaved.

Operative Tactics.—The patient lies in the dorsal position, with a flat pillow under the shoulders. The head is turned towards the opposite side, with a small sand-bag under the cheek.

The surgeon stands on the side of the operation opposite the patient's head; his assistant is at the head of the table; the anæsthetist is opposite the surgeon.

Anæsthetic.—As in most aural operations, chloroform is the preferable anæsthetic, on account of the excessive oozing caused by ether and mixtures containing it. In the meatal operation the surgeon is at the mercy of the amount of bleeding as regards the duration of the operation. If oozing is profuse, the operation may become practically impossible.

Technique.—The surgeon should, as far as possible, make up his mind as to the procedure he will adopt before the anæsthetic is commenced. He should make sure that the head-lamp is satisfactorily centred and focussed before the operation is started.

THE MEATAL OPERATION.—In cases in which the outgrowth is cancellous, it is easily removed by a sharp spoon. The base should be smoothed down, and after the meatus has been well syringed, a narrow strip of gauze plugging is introduced.

For the Removal of a Compact Exostosis.—The meatal operation is only admissible when the meatus is of good size, and can be well opened by a speculum.

The largest speculum which the meatus will admit is introduced, and a good view of the outer face of the exostosis is secured. It is wiped clean and dry. With a sharp tenotome an incision is made from above downwards across the exostosis as far as can be reached, and the incision is prolonged outwards as far as the border of the base of the exostosis above and below. The little flap so marked out is elevated from the bony tumour in an outward direction, and laid flat against the posterior wall of the outer part of the meatus. In this way the next stage is not hampered by ragged edges of soft tissue which ooze continuously, and a most useful covering is secured for a considerable part of the raw surface which will be produced by the operation. The speculum is laid aside; the largest gouge which the meatus will admit is carefully introduced, and the edge is laid to the base of the exostosis. By careful and light tapping the gouge is now driven inwards through the base of the growth in such a direction as to reproduce as exactly as possible the outline of the normal meatus. When the edge of the tool has become well embedded, it is withdrawn, the speculum introduced, and the meatus dried. The surgeon assures himself that the bone has been penetrated in the desired direction, and proceeds to convert the linear incision in the bone into an open **V**-shaped groove by cutting with the small chisel towards the first incision. The chips are washed out or removed by forceps. The groove should be brought to the same depth at its extremities as in the middle by the use of one of the smaller gouges, followed by the chisel. The floor of the groove is now explored with the fine flat elevator or with a quill, in order to make sure that the whole thickness of the outgrowth has not been in any part penetrated. The trench in the bone is now once more cleaned and dried, so that the position of the edge of the larger gouge, which is now reintroduced, can be made out; it is carefully adjusted, and a further cut is cautiously made in the floor of the trench. The fine elevator may now be introduced, and an effort made to rock the exostosis. If it is firm the trench is again broadened and deepened by the small chisel, and its floor re-explored. Owing to the "lead" of the edge of the gouge, penetration may take place first about the centre of the line of attack; more commonly, as the deep aspect of the growth is approached, the ends of the trench are found to be open. A curved steel probe is slipped beyond the growth, so that some idea of the thickness of the remaining parts may be obtained, and these are very cautiously divided by the smaller gouges or the fine chisel. As soon as the main mass can be rocked, it is seized by the Hartmann forceps, and detached by a gentle swaying movement and withdrawn. The meatus is now packed with gauze, and a pause of a few minutes is made to arrest all bleeding. A careful inspection of the meatus is now made, and the position and size of any remainders of the tumour noted. These must be removed by very careful use of the smaller instruments. The membrane is now inspected. Its commonest injury if the operation has been carefully performed is a small detachment posteriorly; this will rapidly heal, and is of no moment.

The meatus and the deep surface of the small flap are now thoroughly irrigated and dried, and the flap is laid down in its natural position. The meatus is finally lightly and evenly packed with narrow gauze plugging.

This operation is at once a most difficult and a most satisfactory one. In suitable cases and in skilled hands it yields results which may fairly be called perfect. If clumsily or impatiently performed, it may end in absolute disaster.

The advantage of using as large a gouge as possible for the main cuts is great. An almost perfectly smooth surface is left for the reformed bony meatus, which even in the parts which remain uncovered rapidly heals without the production of excessive granulations. In addition, the risk of unexpected penetration of the deep surface of the growth, with injury to the membrane, is much diminished. Finally, the operation, though always a slow one, is expedited as far as possible by the use of the large tool.

THE POST-AURAL OPERATION.—This method allows of the attack of all meatal exostoses; it is the only method which is applicable when the cartilaginous meatus is not of good size. While neither so elegant nor so perfect an operation as that conducted through the meatus, it is relatively easy of execution. In the case of an exostosis of the anterior wall, it may be necessary to split the posterior wall of the cartilaginous meatus, after turning the pinna forwards, before a sufficiently free access is gained. The operation resembles broadly the earlier stages of the Radical Mastoid Operation.

The incision is made in the post-auricular furrow, running from its upper end to the level of the floor of the meatus. A dissection is now carried forwards until the posterior aspect of the fibro-cartilaginous meatus is recognized. With the fine elevator this is separated from the bony meatus, care being taken to preserve it as completely as possible, and the auricle, with the soft meatus, is pushed forwards.

The exostosis is now attacked by cutting away the posterior wall of the bony meatus, so that it is removed with its base. This is easy in the more superficial parts, where the bone may be boldly removed, but becomes a more delicate matter as the level of the tympanic ring is approached. The position of the margo-tympanicus must be carefully watched, and injury to the attachment of the membrane avoided. After the completion of the operation on the bone the meatus is remodelled, as in the radical operation, by the formation of a flap from the posterior wall of the fibro-cartilaginous meatus. (See the account of the Radical Operation for detail of this procedure.) The flap is packed backwards at the close of the operation, and the enlarged meatus is lightly filled with gauze.

At the completion of either operation an external dressing of gauze and wool is applied, and fixed with the usual bandage.

After-Treatment.—Pain is not likely to be severe. It may be met, if necessary, by 10 minims of tinct. opii. The first dressing will take place after forty-eight hours. After removing the external dressing, the plugging in the meatus is well soaked and very cautiously removed, great care being exercised not to disturb the position of the flap. The meatus is syringed and dried, and its condition and that of the membrane inspected. The meatus is then again packed, and the dressing renewed. This syringing and packing of the meatus is to be repeated daily until healing is complete. The patient should have an aperient on the evening of the second day. On the third day he may be allowed to get up.

Results.—These will depend almost entirely on the skill with which the operation has been executed. In a good case the lumen of the meatus is restored so completely to the normal that it would be impossible to say that anything had been amiss with it. Along with this there should be a marked recovery of hearing in those cases in which occlusion of the meatus by the growth or by the rapid accumulation of cerumen has caused functional impairment. No recurrence of the disease need be feared. Cases accompanied by suppuration in the middle ear will depend for their results chiefly on the success of the operation on that cavity.

Misfortunes.—As already said, the operation may, if unskilfully performed, end in disaster. This may come about in a variety of ways. The membrane and tympanic structures may be severely damaged, with impairment of hearing, and possibly with the production of an obstinate suppuration in the tympanum. It is quite possible to cut entirely across the facial nerve if the operator loses sight of the true limits of the meatus. Finally, the operation may result in so much laceration of the meatal wall, and so free and obstinate a formation of granulation tissue may follow, that the deeper part of the meatus becomes much strictured, or actually atresic. Of all the conditions which may conspire to make the operation difficult, perhaps the most annoying is a badly-given anæsthetic, with resulting continued oozing, which makes it almost impossible to get a clear view of the field of operation. It may be of much service in these circumstances to pack the meatus repeatedly with gauze soaked in cocaine and adrenalin.

CHAPTER XV

AN OPERATION FOR EARLY MALIGNANT DISEASE OF THE EXTERNAL AUDITORY MEATUS AND MIDDLE EAR

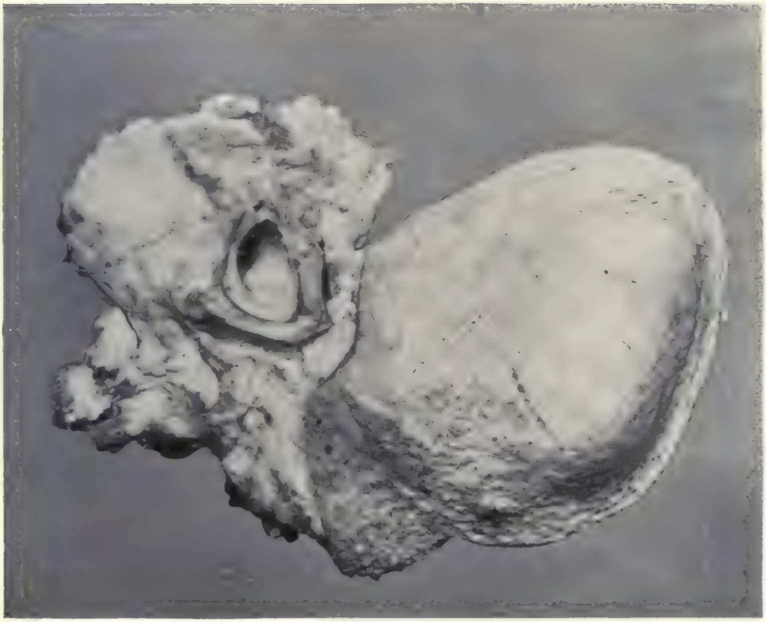
ATTEMPTS to eradicate malignant disease so deep-seated, in such perilous proximity to structures essential to life, and among regions so difficult of access, must always be undertaken with grave apprehension, lest the disease be found to already overreach the bounds of possible removal.

Yet, granted the early recognition of the nature of the disease, and determination and ability on the part of the surgeon who undertakes its removal, we see no reason why malignant disease in these situations should be less successfully treated than malignant disease in other parts of the body.

The commonest form of malignant new growth primarily affecting the external meatus and middle ear is carcinoma. This is usually of the squamous-celled variety, which apparently originates in the fundus of the meatus, whence it invades the neighbouring bone and tympanic cavity.

The operation to be described in outline has been successfully performed when the disease was discovered at an early stage. As a formal procedure it necessitates the removal of the whole of the cartilaginous and osseous portions of the external auditory meatus, with the pre-auricular lymphatic glands and the tissues in which they lie. The nature of the disease makes necessary the thorough examination of the

Plate XV.



PARTS REMOVED BY OPERATION FROM AN EXTENSIVE CASE OF CARCINOMA OF THE EXTERNAL AUDITORY MEATUS.

The specimen includes the cartilaginous meatus with the surrounding parts, a large area of the skin of the cheek, and the whole of the parotid salivary gland.

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tympanic cavity and mastoid process, which is carried out on the lines of the Radical Mastoid Operation.

Beyond this the extent of the operation will depend upon that of the new growth, the possibility of complete extirpation of which will be determined by anatomical considerations.

Indications. — The indications for operation are based upon correct diagnosis, established by histological examination in the early phases of the disease.

In cases with deafness, otorrhœa, or pain, if a new formation of uncertain nature be discovered in the meatus, the possibility of malignancy must never be forgotten.

A friable papilliform growth, or an ulcer in the meatus, should be examined microscopically.

Immediately the clinical features suggest malignancy, the determination of the nature of the growth should be undertaken by histological examination; where possible, a portion may be removed by a snare or curette without an anæsthetic. In other cases a portion should be removed under general anæsthesia, and sections of the suspected growth prepared by the freezing method, while the anæsthetic is continued. As soon as the nature of the disease is determined, its excision should be at once proceeded with.

[The microscopic examination of fragments of growth removed with the curette is of much less value than of pieces excised; for, though the histological appearance of the cells in some curettings may be characteristic, it is often impossible to be sure of the malignant nature of the disease without proof of invasion of surrounding tissues.]

General Preparation of the Patient.—This is the same as for the Radical Mastoid Operation (*q.v.*).

Local Preparation of the Patient.—The skin must be prepared in the same way as in the case of the Radical Mastoid Operation. A larger area must be shaved and disinfected, including the side of the face and neck.

Surgeon's Outfit.—In addition to the outfit enumerated in the description of the Radical Mastoid Operation, the surgeon will need:

Twelve additional pairs of pressure forceps (eighteen in all).
Two thick flat gauze pads.
Larger supply of ligature material.

The arrangements of the operating-table, the position of the patient, surgeon, and his assistants, and the administration of the anæsthetic, are the same as described for the Radical Operation.

Technique.—The following order of procedure is recommended:

1. Preliminary excision and histological examination of a part of the suspected growth.
2. Skin incision.
3. Reflection and preservation of the vitality of the pinna.
4. Isolation and removal of the cartilaginous meatus and pre-auricular glands.
5. Radical tympano-mastoid operation.
6. Completion of the removal of the osseous meatus.
7. Excision of cervical lymphatic glands.
8. Closure and drainage.

STAGE 1. PRELIMINARY EXCISION AND HISTOLOGICAL EXAMINATION OF A PART OF SUSPECTED GROWTH.—If a suitable piece cannot be removed with the knife intrameatally, the meatus is opened post-aurally, by an incision similar to that made in the Radical Mastoid Operation (*q.v.*).

In preparing the sections special attention must be paid to correct orientation, so that the specimen shall show the edge of the growth and adjacent tissue. After hardening by freezing in gum arabic, sections are cut with a sliding microtome, and floated on to water in a black tray. A specimen is selected and transferred to a slide, dried with blotting-paper, and stained with methylene blue. It is covered with a cover-slip, and examined beneath the microscope in the stain.

STAGE 2. SKIN INCISION.—When the preliminary post-aural incision has been made, the upper end of the wound is prolonged downwards and forwards, above the attachment of the pinna, over the parotid region to the level of the tragus.

When the diagnosis has been established by examination of a piece of the growth removed intrameatally, the skin incision is more conveniently commenced in the parotid region, opposite the tragus, below the middle of the zygoma. The skin is divided along a line passing upward to the upper attachment of the pinna, over which the incision sweeps, and, curving downwards $\frac{1}{3}$ inch behind the post-auricular groove, terminates at the apex of the mastoid.

The pinna and adjacent skin are dissected from the superficial fascia so as to expose the meatal wall. The cartilaginous meatus is cut across at its junction with the concha, and the auricle is turned down. A considerable number of vessels bleed freely, and numerous pressure forceps are required to control loss of blood.

STAGE 3. PRESERVATION OF THE VITALITY OF THE PINNA. —The auricle, whose blood-supply is curtailed by the division of the posterior auricular artery and auricular branches of the superficial temporal artery, must be carefully wrapped in hot pads of gauze, which should be renewed from time to time during the subsequent course of the operation.

STAGE 4. REMOVAL OF THE MEATUS AND ITS SURROUNDING TISSUE.—The whole of the cartilaginous meatus must be isolated, with its fibrous capsule. It is convenient to begin by dissecting the pre-auricular lymphatic gland, with the surrounding fibrous tissue, from the surface of the parotid. By working upwards the capsule of the temporomandibular joint is displayed in front, and the tympanic plate behind. The knife is then carried along the suprameatal crest to the line of the post-auricular skin incision, and down to the apex of the mastoid. This avoids opening the temporal sheath. The periosteum is stripped forwards off the mastoid to the outer margin of the osseous meatus. The cartilaginous portion is now completely separated and removed. Care must be taken of the facial nerve. The posterior auricular artery will require to be ligatured in this dissection.

STAGE 5. RADICAL MASTOID OPERATION.—As a necessary means of rendering the tympanum accessible to inspection, and with the object of removing growth, the mastoid antrum and cells are opened, and the adjacent bone removed, in the same manner as is described under Stages 2, 3, and 4, Radical Mastoid Operation.

STAGE 6. COMPLETION OF THE REMOVAL OF THE OSSEOUS MEATUS.—This includes the removal of the tympanic ring and the floor of the tympanum. This can be accomplished in part with the gouge, in part with Jansen's forceps or the cross-handled bone-cutting curette.

The cavity must be thoroughly searched to determine the limits of the growth. This may have destroyed the base of the styloid process, and spread inwards to the internal carotid artery and the pharynx. It may implicate the labyrinth, and may have entered the fundus of the internal auditory meatus, or may have extended forwards and inwards, attacking the apex of the petrous bone. Posteriorly, the mastoid may be deeply and widely infiltrated by growth. The facial nerve may be surrounded, or may be completely destroyed. Under such difficult circumstances, the measure of success attained will depend upon the experience and determination of the surgeon, and upon the endurance of the patient.

STAGE 7. REMOVAL OF CERVICAL LYMPHATIC GLANDS.—If these are involved, their removal must be carried out in accordance with the principles of general surgery.

STAGE 8. CLOSURE AND DRAINAGE OF THE WOUND.—After ligaturing all the vessels which have been divided, the cavity is carefully and thoroughly packed with gauze. Sutures are inserted into the pre-auricular and upper half of the post-auricular parts of the incision, leaving the lower part of the mastoid incision open for purposes of drainage.

The outside dressings are then applied in the usual way.

After-Treatment.—The first step in the after-treatment is to overcome the shock of the operation. The patient is surrounded with hot-water bottles, the foot of the bed is raised, and the head is kept low. If there are any symptoms of collapse, normal saline is injected per rectum or subcutaneously.

The wound is dressed on the third day, the gauze withdrawn, and the cavity irrigated. A cavity which seemed formidable in size at the conclusion of the operation soon becomes smaller. After ten or fourteen days grafting may be advisable. The selection of the time most suitable for grafting depends upon the condition of the wound. Thiersch's grafts are cut and applied in the usual way.

As the cavity diminishes in size it may be closed posteriorly, and treated through the meatus. Having regard to the possibility of recurrence, the patient should be examined at regular intervals.

Results.—The immediate results of this procedure have been most gratifying. As, however, the earliest of our cases of malignant disease of the meatus was operated on only eighteen months ago, we are as yet unable to make any statement as regards ultimate freedom from recurrence.

APPENDIX

THE following abstracts of cases are grouped under the operative procedures which were employed. They have been selected to illustrate various points among the indications for operation, certain complications of the primary forms of disease, and the rare post-operative disasters. A short series of cases has been added to illustrate the application of the operations on the labyrinth, and of that for the removal of malignant disease.

1. INCISION OF MEMBRANA TYMPANI.

Hospital Nurse. Acute Otitis Media following Naso-pharyngitis after Exposure to Infection of Measles. December, 1904.

Temperature on third day 103·2°. No perforation. Incision of membrane; streptococcal infection. Continued high temperature, to 105°. No mastoid signs; discharge free; membrane flat. Leucocytosis, 36,000. Condition suggestive of septicæmia. Treatment by large doses (150 c.cm. in all) of antistreptococcal serum; recovery. Case mentioned in Proceedings of the Otological Society, vol. vi., p. 58.

2. SCHWARTZE'S OPERATION.

Male, æt. 76. Right Otorrhœa for Several Weeks; Pneumococcal Suppurative Mastoiditis; Extradural Abscess; Superficial Abscess. September, 1906.

Abscess appeared entirely behind the mastoid area. Temperature normal. At operation pus was found to have made its way from the interior of the cranium through a vascular opening which led into a large extradural abscess; this communicated by a narrow channel with an abscess in an apical cell in the mastoid. Upper mastoid cells and antrum contained no pus, nor was their mucosa swollen. Pure pneumococcal culture from the pus. Typical Schwartze's operation, with thorough opening of the extradural abscess. Rapid recovery.

3. SCHWARTZE'S OPERATION.

Female, æt. 8. Recent Acute Otitis Media; Extradural (Perisinous) Abscess. January, 1906.

Right discharge of a fortnight's duration stopped three days before admission with the appearance of a post-aural swelling; membrane bulging. Temperature 100·2°. Pus issuing through perforation in outer surface of mastoid on exposure; track led directly into a perisinous abscess. Extreme forward position of the sinus, separated by only a thin compact plate of bone from the canal of the external meatus and from the surface of the mastoid. Drainage of abscess and antrum through incision. Recovery. Pure infection by Streptococcus pyogenes.

4. SCHWARTZE'S OPERATION.

J. E., Male, æt. 43. "Influenzal" Otitis Media; Pneumococcal Mastoiditis.

Admitted February, 1906, four weeks after influenza.

Symptoms. — Otorrhœa, mastoid pain, swelling, tenderness; no fever. Tympanic membrane: small perforation, with swollen mucosa protruding.

Typical Operation. — Extensive cells in mastoid, full of greenish-yellow inoffensive pus; muco-periosteum of cells not swollen. Recovery; perforation healed; hearing unaffected.

Bacteriological Examination.—Pure growth of pneumococci.

5. RADICAL OPERATION.

Male, æt. 42. Chronic Suppurative Otitis Media; Acute Mastoiditis; Bezold's Perforation; Extrapharyngeal Abscess. August, 1904.

Chronic otorrhœa, right side; swelling over and below the mastoid for a fortnight. Temperature normal.

Radical mastoid operation. Mastoid cells well developed, and filled with pale masses of swollen mucosa. Perforation through inner wall of mastoid near tip of process, leading into extrapharyngeal abscess; drainage through enlarged opening, without counter-incision. During recovery vertigo, relieved by curettage of carious area in region of Fallopian aqueduct.

6. RADICAL OPERATION.

W. H., Male, æt. 37. Chronic Suppurative Otitis Media; Extradural (Perisinous) Abscess; Chronic Osteomyelitis of Skull Bones; Cerebral Abscess (Frontal). Death. Pathology: Chronic Streptothrix Infection. September, 1904, to May, 1905.

September 21, 1904.—Radical operation; extradural abscess opened and drained; caries of external arcuate eminence treated by curetting. From first, considerable swelling of temporal and post-aural regions; formation of false membrane in the operation cavity, yielding a pure culture of a diphtheroid innocuous to mice; extradural abscess beneath postero-inferior angle of parietal; double optic neuritis. Cavity healed about middle of October, but some œdema still present over upper part of right occipital bone, and continued optic neuritis. From this time there was a series of subperiosteal abscesses, which formed as softened spots in areas of chronic thickening in the scalp—at first over the right side, but later also on the left. Cultures made by withdrawal of fluid by needle were invariably sterile, except in blood-glucose broth, in which globose masses of a fine Gram negative streptothrix grew. In old cultures the growth took a bacillary, diphtheroid form. In films the same organism was always demonstrable, but no other. Some improvement on heavy doses of potassium iodide (50 grains).

May 16, 1905.—Rapid development of symptoms of cerebral compression; swelling of left upper eyelid and chemosis. Sudden death on May 18.

Post-mortem. — Great thickening of pericranium; diffuse chronic non-suppurative osteomyelitis of skull; subcortical abscess in anterior extremity of right frontal lobe, in material from which the streptothrix was again demonstrable in films, but failed to grow. No evidence of tubercle or syphilis.

7. RADICAL OPERATION.

W. E., Male, æt. 64. Sloughing of Wall of Lateral Sinus after Exposure. October, 1907.

Operation for carcinoma of left external meatus, conducted on the lines of a radical operation. Subsequent delirium tremens. Dressings torn off, and fingers introduced into wound. Violent consequent suppuration, with sloughing of the sinus wall and severe hæmorrhage. No symptoms of sinus pyæmia. Recovery. (See Case 41.)

8. LARGE EXTRADURAL ABSCESS, POINTING NEAR PARIETAL EMINENCE.

F. W., Female, æt. 43. Admitted July, 1908.

Headache and pericranial abscess—left parietal region.

History.—Eight years ago radical mastoid operation left side for chronic otitis media; no otorrhœa since until day before admission. Pains in head for six weeks; conscious, and could walk. Pulse 96; no fever. Did not look very ill. Otoscopy: inner tympanic wall dry; small sinus found with probe upwards and backwards towards antral region.

Operation.—Abscess over parietal eminence incised; bare bone found; no aperture in bone. Cranium opened with gouge through exposed area; large extradural abscess found. Scalp incision prolonged down to apex of mastoid, and whole of exposed part of cranium cut away; antrum contained granulations and pus. Extradural abscess had spread up from the antrum, through tegmen, as high as parietal eminence, near which infection had spread through the bone to the pericranium. Complete recovery.

9. LATERAL SINUS THROMBOSIS.

W. B., Male, æt. 21. Chronic Right Suppurative Otitis Media; Sinus Thrombosis; Cerebral Abscess. Recovery. June, 1906.

Admitted to hospital, June 5, as "query typhoid." Illness began May 31 with sudden severe pain in the right ear; next day great pain in the head, repeatedly sick, rigor. Rigor repeated next day; vomited again on June 3.

On admission temperature 103°, rising to 104°; pulse 96. Foul discharge from right ear; unhealthy granulations in tympanum; sagging posterior wall of bony meatus. Deep tenderness over mastoid, but no œdema; tenderness and thickening over upper part of internal jugular vein.

Operation, June 5.—Pus and cholesteatoma in mastoid; two perisinous abscesses; sinus wall necrotic. Jugular vein tied; contained no clot. Sinus thrombosed from bulb to about one-third of horizontal part. Polyvalent antistreptococcic serum administered: 30 c.c. on 6th, 40 c.c. on 7th, 20 c.c. on 8th and 9th.

No further septic symptoms; temporo-sphenoidal abscess opened on June 15. Recovery. For the latter part of this case see Case 15, under cases of cerebral abscess. For full report see St. Bartholomew's Hospital Reports, vol. xlii., 1906.

Bacteriology.—Streptococcus pyogenes.

10. LATERAL SINUS THROMBOSIS.

Female, æt. 13. Chronic Suppurative Otitis Media, Right; Lateral Sinus Thrombosis. Recovery. November, 1908.

History of discharge of uncertain duration. Ill for a week with frontal headache and rising temperature. Under observation, developed tenderness over mastoid, spreading backwards for 1½ inches along the course of the sinus; also tenderness and enlargement of upper deep cervical glands.

On day of operation, temperature 104°; pulse 120. Severe frontal headache. Leucocyte count 12,600. No rigor in history, nor while under observation.

At Operation.—No pus in mastoid; no extradural abscess; surface of descending part of sinus covered with grey necrotic lymph; cavity contained clot, extending from the anterior third of the horizontal part to lower extremity of bulb. Sinus laid open; bulb curetted, after ligature and excision of internal jugular vein above the level of the hyoid. Recovery without further complications.

11. THROMBOSIS OF JUGULAR BULB.

D. S., Female Child, admitted, 1907, with Left Otitis Media, Earache, and Fever.

Rigors; temperature 103·4°; pulse 140. Tenderness over mastoid and in neck. Very ill; shouting delirium; was thought to have meningitis. Complete tympano-mastoid operation. Perisinous abscess; lateral sinus not thrombosed. Died next day.

Post-mortem.—No meningitis. Lateral sinus infected, but not thrombosed. Narrow tract of endophlebitis on parietal wall of sigmoid sinus, traced down to jugular bulb, which contained septic thrombus. No other intracranial infection.

12. RADICAL MASTOID OPERATION: SUBSEQUENT LOCALIZED ENDOPHLEBITIS; STREPTOCOCCAL ENDOCARDITIS.

Maternity Nurse, æt. 31. Radical Operation for Continued Otorrhœa.

All well after operation until eighth day, when rigor, temperature 102·2°; vomited; severe headache and backache. Headache and vomiting continued with fever until fourteenth day; pulse rose to 120. No physical signs to account for condition. Fever unabated; leucocytosis, 16,960. Wound, no tenderness or swelling; minute drop of pus exuded through upper end of incision; cavity clean. Blood cultivated on sixteenth day; blood-cultures grew pure Streptococcus pyogenes (Gordon). Polyvalent antistreptococcic serum injected. Temperature 103°; pulse 128; respirations 44. Cough; pain in chest; no headache, vomiting, giddiness, twitching, delirium, or rigor. Lumbar puncture; fluid clear, sterile. Seventeenth, eighteenth, and nineteenth days: rigor, and temperature 105·2°, each day. Died nineteenth day.

Post-mortem.—Ulcerative endocarditis, pulmonary valves. Temporal bone: small area of wall of lateral sinus exposed in operation cavity. This was examined histologically. To the inner wall of the vessel was adherent a thin lamina of cellular and young fibrous tissue, replacing the normal tunica intima and endothelium. No organisms detected in sections; no intracranial infection.

Comment. — The post-mortem findings suggest that the blood infection entered through the exposed part of the sinus, without causing thrombosis.

13. THROMBOSIS OF LATERAL SINUS AND JUGULAR BULB.

W. M., Male, æt. 10. Chronic Left Suppurative Otitis Media; Lateral Sinus Thrombosis. Death. December, 1907.

Chronic left discharge. Illness commenced one week before admission, with pain in the head, rigors, and repeated vomiting. Had always been a delicate child, with "something wrong with his heart."

On admission, temperature 100·4°; large left perforation; inner wall of tympanum granulating. Very tender over mastoid antrum, over exact course of sinus from nearly external occipital protuberance to mastoid, and in neck along internal jugular vein. Deep cervical glands inflamed, and masking the vein. Operation immediately. Perisinous abscess opened; sinus wall sloughing. Exposure of sinus from level of floor of meatus to within $\frac{1}{2}$ inch of torcular. Wall sloughing for about two-thirds of this distance. Jugular thrombosed to junction of common facial vein; wall below this thickened for some distance.

Excision of vein to within a finger's breadth of the clavicle. Exposure of jugular bulb by removal of floor of meatus and tympanum; curettage of bulb. Death three hours later.

Post-mortem.—No organic cause of death. Clot had been completely removed.

Bacteriology.—Clot from sinus; streptococci. Heart's blood sterile.

Comment.—The procedure employed is a very severe one, and the death of the patient was probably directly due to the duration and extent of the operation. It is doubtful whether the full exposure of the jugular bulb compensates for the added immediate risks to the patient, as the bulb may be quite satisfactorily emptied and curetted from below and above.

14. TEMPORO-SPHENOIDAL ABSCESS.

A. E., Female, æt. 38. Chronic Otorrhœa, Right Side. Admitted 1907.

Unconscious. Headache two weeks. Otoscopy: granulations in fundus of meatus. Temperature 104°; pulse 72. Diagnosis temporo-sphenoidal abscess. Tympano-mastoid operation and exploration of brain. No extradural abscess. Repeated puncture of temporo-sphenoidal lobe failed to discover abscess. Cerebellum and lateral sinus natural. Died next day.

Autopsy.—Small suprategminal temporo-sphenoidal abscess, very tough walls; puncture track up to abscess wall, which was not penetrated; ventricles distended.

Comment.—This case shows the necessity for the use of a sharp-pointed instrument for exploration of the brain, such as a knife or the special instrument illustrated (p. 106).

15. Temporo-sphenoidal Abscess.

W. B., Male, æt. 21. Chronic Right Suppurative Otitis Media; Sinus Thrombosis; Temporo-sphenoidal Abscess. Recovery. June, 1906. (See Case 9.)

The earlier part of this case is described under Case 9. Development of evident symptoms of cerebral abscess took place during recovery from sinus thrombosis, but the condition was probably present during the whole time. In this connection note the pulse of 96, with temperature of 104°. On the sixth day after the operation on the sinus, drowsiness was marked, and the pulse-rate sank to 60; there was no optic neuritis; temperature normal. Severe headache now set in, and on the tenth day the pulse-rate sank to 46. There was doubtful slight swelling of the right optic disc. No paralyses nor localizing signs.

Operation.—Dura mater over the tegmen necrotic: exploration of the brain here opened a large abscess containing pus, sloughs, and gas.

On being returned to bed the patient stopped breathing, but after artificial respiration for ten minutes, spontaneous breathing was re-established. Convalescence was quite uneventful. Patient now in regular work.

16. TEMPORO-SPHENOIDAL ABSCESS.

W. L., Male, æt. 17. Chronic Suppurative Otitis Media; Extra-dural (Suprategminal) Abscess; Suppurative Encephalitis of Temporo-sphenoidal Lobe. Recovery. September, 1908.

History of bilateral discharge for at least two years. Headache for five weeks—worse during last five days, during which there had been several rigors. No vomiting nor vertigo.

Both membranes gone; granulations on inner tympanic wall on each side. Some tenderness on pressure over upper part of left mastoid. No nystagmus, squint, nor optic neuritis; no palsies of cranial nerves. Slow cerebration. Temperature 100°; pulse 85.

Immediate Radical Operation. — Suprategminal abscess. Dura mater above abscess softened and necrotic. Small very offensive temporo-sphenoidal abscess opened immediately above this area of dura mater. Drainage by tube. Slight temporary improvement, followed by increasing drowsiness. On fifth day after first operation sudden rise of temperature to 104·6°, pulse remaining at 92. Very drowsy, with great headache.

Second Operation.—Removal of large area of bone and exposure of sloughing interior of temporo-sphenoidal lobe by scooping away the overlying parts. Recovery.

This case was reported in full detail to the Otological Section of the Royal Society of Medicine, December, 1908.

17. SINUS THROMBOSIS; TEMPORO-SPHENOIDAL ABSCESS.

Male, æt. 30. Chronic Right Suppurative Otitis Media; Cholesteatoma; Thrombosis of Lateral Sinus; Temporo-sphenoidal Abscess. Death. December, 1903.

History of pain and headache seven days before admission. Five days later pain in right side of neck. Vomited and was delirious.

On admission, temperature 101°; pulse 56; drowsy and irritable; only partially conscious. Headache, right lateral and frontal. Pain in right side of neck. No optic neuritis; right pupil dilated; right external squint and ptosis. Upper deep cervical glands enlarged.

Later, rigor; temperature 104·2°.

Operation same day. Lateral sinus opened and plugged; temporo-sphenoidal abscess opened and drained. Abscess contained pus and sloughs. Death, without relief of symptoms, six days later.

Post-mortem.—Ventricular system full of pus; abscess communicating with cavity of lateral ventricle.

Comment.—This case illustrates again, like that quoted under Nos. 9 and 15, the clinical features of the conjunction of sinus thrombosis with temporo-sphenoidal abscess. It also shows the failure of relief by simple drainage in cases of cerebral abscess with sloughing encephalitis. In this connection compare Case 16.

18. Cerebellar Abscess.

B., Male, æt. 15. Chronic Right Suppurative Otitis Media; Cholesteatoma; Erosion of External Semicircular Canal; Acute Labyrinthitis; Cerebellar Abscess; Meningeal Symptoms. Death. January, 1908.

History of at least three years' right otorrhœa. Ten days before admission, after pushing wool into the ear, he felt something give way and became giddy. Giddiness continued for two days, accompanied by vomiting, which persisted. Severe headache on fifth day and subsequently; delirium. No rigor.

On admission, offensive right purulent discharge; meatus blocked by polypoid granulation mass. No mastoid symptoms. Some retraction of head, with stiffness of muscles of back of neck. No palsies. Eye-grounds natural. Kernig's sign present. Knee-jerk exaggerated; occasional clonus on tapping ligamentum patellæ.

Preliminary lumbar puncture; 2 ounces of turbid fluid removed under pressure. Cell contents almost entirely polymorphonuclears; fluid sterile; no organisms visible in films after centrifugalization.

Radical Mastoid Operation.—Cholesteatoma. Fistula of external semicircular canal; pus in vestibule. Double vestibulotomy; post-labyrinthine drainage of meninges of posterior fossa. Marked improvement till the seventh day: disappearance of headache and vomiting. On the eighth day reappearance of headache, pulse slowing to 60. Plantar reflex variable; patellar tapping evokes clonus; ankle-clonus on right. No improvement on lumbar puncture. Next day pulse dropped to 54. Exploration of cerebellum; negative result. Temporo-sphenoidal lobe also explored without result. Lateral ventricle punctured; about 2 ounces of clear fluid escaped. Death on twenty-second day of illness.

Post-mortem.—Large cerebellar abscess lying in upper part of lateral lobe, far back. No cerebral abscess; no meningitis.

Comment.—Confusion between serous meningitis and cerebellar abscess, or the missing of the certain diagnosis of a cerebellar abscess on account of coincident serous meningitis, as in this case, is rendered the greater by their frequent common etiology in an infection of the labyrinth. For further cases illustrating this point, see both the subsequent cases of cerebellar abscess and those of meningitis quoted under Nos. 36-41. The fatal ending of this case was due to the unusual position of the abscess.

19. CEREBELLAR ABSCESS.

M. A., Female, æt. 27. Chronic Suppurative Otitis Media, Left; Labyrinthitis; Extradural (Perisinous) Abscess; Cerebellar Abscess. Recovery. May, 1908.

History of left discharge from infancy. Recent vertigo, pain in the ear, and frontal headache, with repeated vomiting.

Large loss of membrane; granulations in lower part of tympanum. Slight redness, and pain on firm pressure over the mastoid. Temperature 98°; pulse 92. Objective vertigo to left. Spontaneous nystagmus: on deviation to right, rapid short excursions downwards and outwards; on deviation to left, long slow excursions, horizontal. No optic neuritis. Tends to fall to left.

Hearing Tests.—Weber referred for all forks to right. Fork 2048 *d.v.*, inaudible on left side.

Radical Operation.—Fistula of promontory; inferior vestibulotomy. Headache and occasional vomiting continued, pulse slowing to 55.

Five days after first operation, lumbar puncture; withdrawal of 6 drachms slightly turbid fluid. Cell contents: polymorphonuclears, 60 per cent.; lymphocytes, 40 per cent. Fluid sterile on cultivation. Temporary relief of headache. Next day return of headache; slight retraction of the head; doubtful response to Kernig's and Babinski's tests.

Second Operation.—Six days after first operation, exploration of posterior fossa. Small extradural abscess opened in lateral sulcus. Cerebellar abscess opened, containing 1½ drachms of offensive pus. Drainage of abscess by tube. Subsequent course uneventful. Complete recovery.

Comment.—Some confusion was created in this case by the coincidence of labyrinthitis with cerebellar abscess. The occurrence of phenomena suggesting a mild meningitis is common in cerebellar abscess, and appears to be connected with the presence of an excess of cerebro-spinal fluid, which, as in this case, is relatively rich in cell contents, with a preponderance of polymorphonuclear leucocytes.

20. CEREBELLAR ABSCESS SECONDARY TO LABYRINTHITIS; INFLAMMATORY ŒDEMA OF BRAIN, RELIEVED BY PERMITTING HERNIATION; RECOVERY.

T. C., Male, æt. 28. Chronic Suppurative Otitis Media, Left Side.

Past history of vertigo; headache for one month; recent vomiting and malaise. Rombergism: swerving to the right. Nystagmus, rotatory to the right, slight, and markedly oblique to the left. Inco-ordinate movements of left hand; retraction of head; Kernig's sign present. Temperature 98°; pulse 72. Violent occipital headache.

Complete Tympano-mastoid Operation. — Found labyrinth completely destroyed, and adjacent dura mater of posterior fossa adherent to cerebellum, which contained foul pus. Abscess drained through inner and posterior wall of antrum. For three days no relief of headache; very restless, noisy. Pulse 52.

Second Operation.—Dura mater exposed in region of operation cavity more freely, above and posteriorly. After excluding temporo-sphenoidal abscess and ventricular distension, by puncture, dura mater of posterior fossa was incised, from lateral sinus to internal auditory meatus, to permit free herniation of the cerebellum.

Result.—Inflamed cerebellum rapidly filled the operation cavity; relief of symptoms of intracranial pressure. Subsequent complete recovery.

Patient reported and shown to Otological Section, Royal Society of Medicine, December, 1908.

21. Cerebellar Abscess secondary to Lateral Sinus Thrombosis and Perisinous Abscess.

T. B., æt. 7. Chronic Suppurative Otitis Media, Right Side.

Admitted with headache and vomiting; one rigor before admission. Retraction of head. Lumbar puncture; turbid fluid, with excess of polymorphonuclear leucocytes. No mastoid tenderness or swelling. Very ill; meningeal symptoms.

Operation.—Perisinous abscess opened. General condition became worse, and death took place.

Autopsy.—Lateral sinus thrombosis; very little disintegration of clot. Large very foul cerebellar abscess, leaking on tentorial surface, with local meningitis.

Comment.—This case was left too late before admission. It illustrates the conjunction of lateral sinus thrombosis and cerebellar abscess, which is not uncommon.

22. CEREBELLAR ABSCESS.

Female, æt. 3½. Chronic Right Suppurative Otitis Media; Chronic Infective Labyrinthitis; Cerebellar Abscess. Death. June, 1903.

This case was recorded under title, "Two Intracranial Cases," St. Bartholomew's Hospital Reports, 1903. Its chief clinical interest was the occurrence of repeated convulsions for a week before death. At the date of the report the significance of the post-mortem finding of a carious labyrinth in these cases was not understood by us, and no emphasis was laid on this feature. At the post-mortem a probe could be readily passed through a hole in the inner tympanic wall and brought out in the internal meatus. There was great distension of the subarachnoid space and of the ventricles, as is usual in unrelieved cases of cerebellar abscess.

23. DOUBLE VESTIBULOTOMY, WITH COMPLETE REMOVAL OF COCHLEA AND SEMICIRCULAR CANALS.

I. M., Female, æt. 22. Chronic Suppurative Otitis Media; Chronic Progressive Labyrinthitis, chiefly affecting the Cochlea. August, 1903, to April, 1904.

This case was reported in full in the *Lancet*, May, 1904. It is of interest historically as being, we believe, the first recorded case of "complete extirpation of the labyrinth for infective disease" in England. It was also the first of the cases of operation on the labyrinth recorded by either of the authors.

24. DOUBLE VESTIBULOTOMY.

R. P., Female, æt. 5½. Chronic Suppurative Otitis Media, Right; Mastoid Fistula; Cholesteatoma; Fistula of External Semicircular Canal and Fenestra Ovalis.

Symptoms.—In infancy, right mastoid abscess; fistula persisted; recent giddiness, and "room going round." No spontaneous nystagmus present at time of operation.

Operation, November, 1904.—Complete tympano-mastoid; double vestibulotomy.

Result.—Complete healing; no facial paralysis; four years later perfectly well. (Reported in *Lancet*, December, 1907.)

Comment.—The above case is interesting on account of its being the earliest in which the set operation was performed throughout with gouges and mallet, without the use of the burr, which was employed to open the labyrinth in the previous cases.

25. SUPERIOR VESTIBULOTOMY, WITH COMPLETE REMOVAL OF SEMICIRCULAR CANALS.

C. C., Female, æt. 25. Old Radical Mastoid Operation for Chronic Left Discharge and Vertigo; Cessation of Discharge, with Increased Vertigo, continuous with Paroxysms. September, 1904.

Operation.—Reopening of radical operation cavity; complete removal of whole length of semicircular canals with the burr; vestibule opened above the facial nerve only.

Result.—Temporary intensification of the vertigo, followed by its complete disappearance.

Comment.—This operation was done when we had not yet learned that vestibulotomy with curetting of the vestibule and ampullæ was adequate for the treatment of vertigo. The case is of value in the history of the simplification of operative procedures on the labyrinth.

26. DOUBLE VESTIBULOTOMY.

J. G., Male, æt. 11. Chronic Left Suppurative Otitis Media; Cholesteatoma; Acute Labyrinthitis; Necrosis of Labyrinth. February, 1907.

History of scarlet fever at two, with left otitis media, which had continued ever since. Attack of pain and facial paralysis two months ago.

On admission, loss of membrane and ossicles; granulations growing out of the tympanum along the floor of the meatus.

At operation, fistula of external canal and roof of vestibule; fistula of inner tympanic wall into vestibule. Sequestrum removed, consisting of the three canals and parts of the walls of the vestibule and internal auditory meatus.

Result.—Complete healing, with much improvement of the facial paralysis.

Specimen shown at Otological Society, 1907.

27. DOUBLE VESTIBULOTOMY.

H. M., Male, æt. 13. Chronic Left Suppurative Otitis Media; Acute Labyrinthitis; Necrosis of Labyrinth. October, 1907.

History of long-standing left discharge. A week before admission was suddenly seized with severe giddiness and vomiting, with pain in the head and occipital headache.

On admission giddiness had disappeared; headache continued severe.

Radical Mastoid Operation. — Surface of external canal eroded, but lumen not open. Wall so softened that lumen was easily opened by scraping with a small spoon; dark-coloured fluid escaped; double vestibulotomy. Commencement of facial paresis four days later. Persistent formation of granulations on inner wall of tympanum.

Second Operation, December, 1907. — Removal of two sequestra—the larger comprised of canals and floor of vestibule, the smaller of the modiolus of the cochlea.

Result.—Complete healing of the cavity; disappearance of facial paresis.

28. INFERIOR VESTIBULOTOMY, WITH COMPLETE REMOVAL OF COCHLEA.

B. T., Female, æt. 20. Chronic Suppurative Otitis Media, Right.

Symptoms.—Recently repeated headaches; giddiness; tinnitus; Rombergism. No spontaneous nystagmus present at time of examination.

Complete Tympano-mastoid Operation not followed by relief. Operation cavity reopened; fistula discovered below stapes into vestibule. Cochlea and vestibule opened with gouge. Curettings from labyrinth consisted histologically of well-formed granulation tissue and cancellous bone. Cerebro-spinal fluid escaped for twenty-four hours from fundus of internal auditory meatus.

Result. — Complete recovery. (Reported in *Lancet*, December, 1907.)

Patient shown at meeting of Otological Section, Royal Society of Medicine, December, 1907.

29. DOUBLE VESTIBULOTOMY.

M. H., Female, æt. 17. Chronic Suppurative Otitis Media, Right Side.

Vertiginous four weeks; granulations right tympanum. November 15, 1908, spontaneous nystagmus, rotatory to right, arrested by irrigation with cold water, which produced rotatory nystagmus to left. On November 18 there was spontaneous rotatory nystagmus to the left, and none to the right.

Rotation Tests.—Rotated three times, head erect, at rate of one revolution in five seconds, clockwise, produced horizontal nystagmus to the left, none to the right. Counter-clockwise, no nystagmus to the right.

Caloric Tests.—Irrigation of right ear with hot (120°) and with cold (70°) water, head erect, does not cause giddiness or alter existing rotatory nystagmus to the left; irrigation of left ear with cold water (70°), head erect, produces rotatory nystagmus to the right, and arrests nystagmus to the left.

Hearing Tests. — Complete loss of air-conduction for C. 32 V. to C. 256 V., and slight loss of air-conduction for C. 2048 V.; slight loss of bone-conduction for C. 512 V.

Complete Tympano-mastoid Operation. — Base of stapes absent; small fistula of outer crus of external semicircular canal; double vestibulotomy. Recovery; rotatory nystagmus to the left unchanged by operation, but subsequently gradually diminished.

30. DOUBLE VESTIBULOTOMY.

R. T., Male, æt. 24. Chronic Suppurative Otitis Media, Left Side.

Admitted July, 1908, with vertigo and vomiting of three days' duration.

On admission, temperature 100°; pulse 70. Looked ill. Polypoid granulations in fundus of left external auditory meatus. Foul pus; mastoido-meatal fistula discovered with probe. Rombergism; falling to the right. Spontaneous bilateral nystagmus—horizontal to left and rotatory to right. Meatal compression with finger caused violent vertigo, and patient nearly fell.

Hearing.—No loss of bone-conduction. Weber to left.

Complete Tympano-mastoid Operation. — Large fistula of ampulla of external canal, and destruction of outer crus of external canal. Stapes and aqueductus Fallopii intact. Double vestibulotomy; immediate relief of symptoms, and disappearance of nystagmus to the left. Recovery, and early disappearance of nystagmus to right.

31. INFERIOR VESTIBULOTOMY.

A. C., Female, æt. 37. Chronic Suppurative Otitis Media, Left Side. November, 1908.

Spontaneous rotatory nystagmus to the right; recent severe vertigo.

Complete Tympano-mastoid Operation. — Stapes absent. Erosion of pelvis ovalis and Fallopian aqueduct, with facial nerve exposed. Inferior vestibulotomy. After healing, giddiness persisted. Typical ablation reactions to rotation and caloric tests. Spontaneous nystagmus rotatory to the right, and oblique to the left. General health very poor. Pulse 100 to 120. Signs of phthisis discovered.

32. INFERIOR VESTIBULOTOMY, WITH PARTIAL REMOVAL OF COCHLEA.

C. B., Male, æt. 16. Chronic Suppurative Otitis Media, Right Side.

In April, 1908, laid up with giddiness. In May, superficial mastoid abscess and facial paralysis.

Complete Tympano-mastoid Operation.—Granulations in tympanum. In June, facial paralysis recovered; growth of granulations persisted.

In November **second operation.** Wound reopened. Discovered cochlea and vestibule invaded by granulation tissue below the Fallopian aqueduct. Upon opening up vestibule and removing diseased cochlea, further granulations were discovered, invading internal auditory meatus. Immediate skin-grafting of mastoid cavity. Recovered. After operation, typical ablation reactions obtained, and occasional slight spontaneous rotatory nystagmus to the left.

Comment.—We have on several occasions met with cases of this class, so that we have come to regard the persistent growth of granulations after the complete tympano-mastoid operation as a condition not infrequently associated with labyrinthitis of this type. In young subjects there may be a history of vertigo; there is no giddiness at the time of the operation, and as a rule no spontaneous nystagmus.

33. SUPERIOR VESTIBULOTOMY (DISCARDED OPERATION).

A. W., Male, æt. 12. Chronic Suppurative Otitis Media, Left Side. Admitted 1906.

Before admission laid up ill at home for about two weeks. On admission mastoid tenderness, but no fever.

Complete Tympano-mastoid Operation.—Unsuspected fistula of external ampulla discovered leading into vestibule; fistula enlarged, and vestibule opened above the facial nerve (superior vestibulotomy). On the third day temperature rose to 103°; signs of meningitis supervened. Lumbar puncture revealed turbid fluid, with pure streptococci. Lived two weeks.

Post-mortem Examination. — Diffuse purulent leptomeningitis; plastic exudate in pia-arachnoid sheath of seventh and eighth nerves, from internal auditory meatus to pons and medulla. No plastic effusion into other cranial nerve sheaths; no other intracranial complications. (*Male Surgical Register*, St. Bartholomew's Hospital, vol. iii., Case 1,939; 1906.)

Comment.—This case illustrates the inadequate drainage of the vestibule which the single opening above the facial nerve affords. Had the vestibule been also drained below by removal of its outer wall (double vestibulotomy), it is probable this patient's meninges would have escaped infection. In the light of recent experience, his survival for two weeks suggests that the type of meningitis was not the most virulent, and we should not now regard such a case as hopeless.

34. ACUTE LABYRINTHITIS: MENINGITIS WITH ACUTE INTERNAL HYDROCEPHALUS.

J. O'G., Male, æt. 14. Chronic Suppurative Otitis Media, Left Side.

History.—Long period of otorrhœa. One eyeball removed for keratitis; nearly blind from same cause in the other. Otoscopy: granulations in fundus of meatus, obscuring landmarks.

Complete Tympano-mastoid Operation.—Extremely forward position of lateral sinus; no ossicles discovered; promontory of cochlea and external semicircular canal normal. No attempt made to ascertain presence of base of stapes. After operation vomited daily for five days. On sixth day headache began, increased in severity; sudden death on ninth day, without previous loss of consciousness.

Autopsy.—Streptococcal pus in vestibule; granulations in pelvis ovalis; stapes absent. Distension of pia-arachnoid of seventh and eighth nerves, with turbid fluid; distension of all ventricles of brain, with apparently clear fluid under great tension. No plastic meningitis; no extradural abscess. Venous sinuses and brain substance free from infection.

Comment.—This case was fully reported in *Archives of Otology*, vol. xxxvii.: "A Case of Acute Hydrocephalus Secondary to Streptococcal Infection of the Labyrinth." The infection of the vestibule was apparently the result of the operation on the tympanum. Although there was no instrumental inoculation, granulations in the pelvis ovalis, which replaced the stapes, failed to withstand the ingress of streptococci. With present knowledge, the infection of the vestibule would probably be diagnosed. Inferior vestibulotomy would almost certainly have saved the meninges from infection, and even subsequently, after signs of increased intracranial pressure had arisen, lumbar drainage, combined with translabyrinthine drainage, would probably have saved life.

35. UNSUSPECTED LABYRINTHITIS; SEROUS MENINGITIS; EXPLORATION OF BRAIN; PURULENT ENCEPHALITIS. AUTOPSY.

S. L., Male, æt. 20. Chronic Suppurative Otitis Media, Left Side; Complete Deafness; Left Facial Paresis.

On admission, temperature 99·4°; pulse 56. Headache; retraction of head. Kernig's sign; vomiting. Lumbar puncture: turbid fluid; cellular deposit; no organisms detected. Spontaneous nystagmus occasional, rotatory to right. Complete tympano-mastoid operation. Granulations in tympanum. Cerebro-spinal fluid escaped from meninges through incised dura mater. Brain puncture negative.

Result.—Headache and retraction relieved for a time; seemed to be getting quite well; sat up, read paper, played draughts. Owing to return of headache and drowsiness, wound reopened, and temporo-sphenoidal wound explored in region of previous puncture. Small abscess found and drained, with complete relief of pain. Rapidly spreading encephalitis set in, and the patient succumbed.

Autopsy.—Extensive softening in the temporo-sphenoidal lobe, around small completely drained abscess cavity. Intraventricular distension; turbid fluid. No plastic meningeal exudate. Histological examination of labyrinth showed complete disorganization of membranous labyrinth; bony capsule intact; path of infection to labyrinth could not be discovered. (Fenestra rotunda not examined microscopically.)

Comment. — This case occurred before we realized the significance of the symptoms. We feel justified in thinking that, in the first instance, it belonged to the hopeful class of meningitis. The brain infection was a misfortune. The type of encephalitis was one which is particularly dangerous. Case 15 shows that the condition, grave though it be, is not hopeless if adequate measures are undertaken.

36. TRANSLABYRINTHINE AND LUMBAR DRAINAGE.

N. C., Male, æt. 12. Chronic Suppurative Otitis Media, Right Side. Admitted April, 1908.

History.—General health good until day before admission; then earache, giddiness, and vomiting. Temperature 97·2°; pulse 80 to 100. Frontal headache. Otoscopy: Tympanic membrane gone; tympanum contained pus. Complete aerial loss of hearing to forks with right ear; contracted auditory field by bone-conduction. Weber to the left. Rombergism; spontaneous rotatory nystagmus to left.

Immediate Tympano-mastoid Operation. — Found stapes separated from fenestra ovalis. Erosion of eminence of external semicircular canal; dark-coloured contents within canal visible through eroded area. Double vestibulotomy; membranous labyrinth and endosteum removed, and found to be intensely inflamed. (Specimen preserved.) Internal auditory meatus not opened.

Within thirty-six hours symptoms of meningitis declared themselves. Lumbar puncture revealed cloudy cerebro-spinal fluid, containing 62 per cent. polymorphonuclear leucocytes in centrifugalized cellular deposit, and pure long-chained *Streptococcus pyogenes* (Gordon's reactions) on cultivation. Headache, retraction of the head, Kernig's sign, and vomiting were present. Temperature 104°; pulse 128; fell to 75. Blood leucocytosis 35,000.

Translabyrinthine drainage combined with continuous lumbar drainage. Disappearance of headache and retraction of the head. Pulse-rate rose to 100–120. Cultures of peripheral blood teemed with the same streptococci. Sterilized saline emulsions of cultivated organism supplied by the Pathological Department, and injected subcutaneously without obvious beneficial results. Lived four days from first operation.

Autopsy.—Examination of head only allowed. Plastic exudate of pia-arachnoid over whole of brain. No ventricular or cisternal distension. Substance of brain and venous sinuses normal. Specimen of temporal bone illustrates outer drain *in situ*, p. 135.

37. Post-labyrinthine Drainage and Lumbar Puncture.

C. G., Male, æt. 8. Admitted 1907, with Symptoms of Right Labyrinthitis and Meningitis.

History of complete mastoid operation, right side, four months previously, and of residual mastoid abscess opened two months before admission. Facial paralysis developed subsequently, independent of operation.

Condition on Admission.—Semiconscious. Unhealed operation cavity right ear. Intermittent fever, 101° to 103°; pulse 96 to 120; respiration 24. Headache; retraction of head. Kernig's sign. Nystagmus; slight nystagmus to the left. Lumbar puncture revealed cloudy fluid containing pure streptococci.

Operation.—Mastoid wound reopened; dura mater incised; brain punctured. Escape of cerebro-spinal fluid from base. Post-labyrinthine drainage. General condition greatly improved after operation; seemed to be getting quite well. Two weeks later died of pneumonia, without return of intracranial symptoms.

Autopsy.—Pneumonic lungs. Meninges showed remains of green plastic exudate in pia-arachnoid around pituitary body, and in dorsal region of spinal cord. No distension of ventricles of brain, and no brain abscess, extradural abscess, or sinusitis.

38. POST-LABYRINTHINE DRAINAGE.

F. S., Male Infant, æt. 6 months. Admitted with Foul Bilateral Otorrhœa, 1907.

Ill at home three weeks; facial paralysis one week. Temperature 100·2; pulse 140; respirations 40 per minute. No squint nor paralysis of limbs; no nystagmus.

Complete Tympano-mastoid Operation. — Granulations in antrum. Exploration of brain; puncture of lateral ventricle; escape of cerebro-spinal fluid under pressure. Six days later head retracted; seventh day, clonic contraction of hands—first in right, then left. General convulsion followed, lasting seven minutes. Second convulsion four hours later, followed by internal squint. **Cranium reopened** through mastoid cavity. Cerebro-spinal fluid escaped from base, through posterior cranial fossa, but the child succumbed next day. Streptococci isolated from cerebro-spinal fluid.

Autopsy.—Pia-arachnoid infiltrated with greenish-yellow pus over the sides and vertex of brain, with turbid fluid at the base. Labyrinths examined histologically. Left seat of acute inflammatory cell infiltration, in cochlea and vestibule; external semicircular canal, stapes, and promontory of cochlea intact. Pathway of infection from tympanum to labyrinth not discovered. (Note.—Sections not yet cut through fenestra ovalis.)

39. CARCINOMA OF EXTERNAL AUDITORY MEATUS AND MIDDLE EAR.

G. K., Hawker, Male, æt. 60. Chronic Suppurative Otitis Media, Right Side, since Childhood. Admitted 1907.

Increased discharge for ten months, and severe pain for two months; recent facial paralysis, right side. Otoscopy revealed mass of growth in meatus, which was at first thought to be inflammatory granulation tissue, but which, on subsequent microscopic examination, proved to be squamous-celled carcinoma. No enlarged lymph glands palpable.

Complete Tympano-mastoid Operation.—The whole of the osseous meatus found to be destroyed by the growth, which had infiltrated the bone of the mastoid, and extended forwards and upwards into the root of the zygoma and temporal fossa above the temporo-mandibular joint. The tympanic plate and base of the styloid process were destroyed, and the dura mater of the middle fossa was widely exposed by disease. When the nature of the disease had been proved by microscopy a second operation was attempted; but the patient died two weeks after the first operation, with a small supra-tegminal encapsuled temporo-sphenoidal abscess and localized streptococcal lepto-meningitis.

40. CARCINOMA OF EXTERNAL MEATUS.

S. S., Male, æt. 45. Carcinoma of Left External Meatus. June, 1907.

History of pain in left ear for at least two years; discharge only for a few months; lately slight bleeding from the ear.

Thin discharge from the meatus. Meatus obstructed about junction of cartilaginous and bony parts by swelling, involving all walls, with papillated surface at its outer margin. No swelling over mastoid or in front of tragus; no enlargement of cervical glands. Tympanum unaffected. Microscopically, typical squamous-celled carcinoma, with cell-nests. **Radical operation and excision of meatus.** Free from recurrence when last seen, January, 1909.

41. CARCINOMA OF EXTERNAL MEATUS.

W. E., Male, æt. 64. Carcinoma of Left External Meatus. October, 1907.

History of slight deafness for nine months; pain in left ear for two months; discharge for six weeks—at first of blood, later of pus. Four weeks before operation a small sequestrum was removed from the deeper part of the floor of the meatus, consisting of a part of the tympanic plate.

Floor of the inner half of the meatus occupied by a firm, pale, smooth ridge of tissue. Deep to this, but external to the membrane, was a hole in the bony wall of the meatus. Membrane appeared quite normal as far as it was visible. The ridge grew perceptibly under observation, and a second sequestrum was removed from the floor of the meatus.

At operation for its removal, the growth was found to have penetrated rather deeply into the posterior part of the tympanic plate and adjacent posterior wall of the tympanum. Dissection of whole of descending part of facial nerve. Microscopically, typical squamous-celled carcinoma. So far no recurrence, January, 1909.

42. CARCINOMA OF EXTERNAL MEATUS.

Male, æt. 22. Carcinoma of Right External Meatus. September, 1908.

History of discharge from the right ear for four weeks, with some attacks of pain. Meatus filled in deeper part by a pedunculated growth having a hard nodular surface. A part removed by snare proved to be carcinomatous. No palpable glands in front of tragus, nor on mastoid, nor in posterior triangle.

At operation of excision of growth, further masses of growth were found lying in the deeper part of the meatus, but there was little evidence of infiltration of the wall of the meatus. Tympanum unaffected; no otitis media. One or two small preauricular glands were removed, and also those over the lower part of the mastoid, which appeared slightly enlarged.

43. CARCINOMA OF EXTERNAL MEATUS.

W. E., Male, æt. 68. Chronic Suppurative Otitis Media, Right; Carcinoma of External Meatus, with Secondary Growths. October, 1908.

History of long-standing discharge in right ear; pain for some months, with development of a swelling on the cheek.

Meatus blocked by a polypus of irregular surface and hardness. Parotid region occupied by a large swelling, over which the skin was adherent, and looked almost broken through. A part of the swelling was soft and contained fluid. The mass was partially fixed to deeper structures. A large number of enlarged glands were palpable in both triangles of the neck on the right side. Later an irremovable mass was discovered in the right side of the root of the tongue. (See Plate XV.)

Histological examination of a part of the growth removed by snare: carcinoma.

At operation on the ear, removal of usual parts, together with the whole of the parotid gland and the masseter muscle in one piece. Subsequent skin-grafting of the gap on the cheek. Recovery, with loss of pain and general improvement of condition. Last seen January, 1909; disease in tongue in advancing condition. No return of disease in ear.

44. CARCINOMA OF EXTERNAL MEATUS.

Male, æt. 27. Carcinoma of Right External Meatus. April, 1907.

Large lobulated mass projecting from the right meatus; indurated swelling and adhesion of skin, both in front of and behind the ear; enlargement of cervical glands. A portion of the growth removed by snare and submitted to histological examination proved it to be a squamous-celled carcinoma. On the nature of the case being explained to them, patient's friends refused further treatment.

45. Carcinoma of External Meatus.

Male, æt. 47. Carcinoma of Right External Meatus. December, 1908.

History of bilateral discharge since measles, in 1868. Persistent pain in right ear during last eight months. Increasing deafness; some tinnitus.

Floor of right meatus occupied by a raised ulcerated mass, the outer margin of which was distinctly papillomatous, with a central longitudinal fissure. No glands palpable.

Histology: typical squamous-celled carcinoma, with cell-nests.

At operation the growth was found to have penetrated the floor of the meatus, and to have destroyed the anterior half of the tympanic plate, a part of which was removed as a sequestrum. Immediate skin-grafting of the operation cavity.

Comment on Cases of Malignant Disease of the Ear.—The foregoing series of cases has occurred in the clinic at St. Bartholomew's Hospital within the space of two years, and we think that its significance cannot be missed. Cases of carcinoma of the ear have in the past been regarded as comparatively rare occurrences; they ought to be considered of such frequency that every surgeon should be continually on the look-out for them. If this were so, we believe that many more would be recorded, especially if every case in which any suspicion is entertained were promptly investigated histologically.

Case 39 suggests that some at least of these cases have died in the past of cerebral invasion and secondary infection, without the true nature of the disease being apprehended. Others with secondary growth in the cervical glands and small growth in the meatus have probably taken their place among those cases which used to be catalogued as "primary carcinoma of lymphatic glands." Others with extension into the parotid, as in Case 43, may have been described as carcinoma of that gland.

In each of our cases the nature of the growth has been conclusively demonstrated by histological examination. We are of opinion that in all the cases of carcinoma the growth originated in the external meatus; in most of them this was obviously so.

The importance of early diagnosis needs no elaboration.

46. SARCOMA OF PINNA.

Male, æt. 25. Round-celled Sarcoma of Right Pinna, occupying the Hollow of the Scaphoid Fossa and Outward to the Margin. May, 1908.

Swelling commenced seven months ago. Cartilage destroyed at the upper part of the margin; growth softening in part; mucoid fluid withdrawn on puncture; skin adherent. Swelling rapidly increased under observation. Histological examination: round-celled sarcoma.

Amputation of upper two-thirds of right pinna. No recurrence to date.

Fuller consideration of the grounds on which some of the generalizations with regard to clinical and operative procedures have been based may be found in the following papers and publications, to which those specially interested are referred:

BY C. ERNEST WEST.

"Two Intracranial Cases," St. Bartholomew's Hospital Reports, 1903, vol. xxxix., p. 37.

"Two Cases of Extirpation of the Labyrinth," St. Bartholomew's Hospital Reports, 1904, vol. xl., p. 93; see also Lancet, 1904, vol. i., p. 1570.

"A Case of Lateral Sinus Thrombosis and Temporo-Sphenoidal Abscess: Recovery," St. Bartholomew's Hospital Reports, 1906, vol. xlii., p. 149.

"Notes on the Infection in Acute Otitis Media and Consecutive Suppurative Mastoiditis," St. Bartholomew's Hospital Reports, 1907, vol. xliii., p. 142.

"Tuberculosis of the Petrous Bone," Lancet, 1907, vol. ii., p. 1321.

"A Case of Purulent Encephalitis: Recovery," Proceedings of the Royal Society of Medicine (Otological Section), 1908, vol. ii.

By SYDNEY SCOTT.

"Three Successful Cases of Operation on the Labyrinth," Lancet, 1907, vol. ii., p. 1676.

"A Case of Acute Internal Hydrocephalus secondary to Streptococcal Infection of the Labyrinth," Archives of Otology, 1908, vol. xxxvii., No. 2.

"A Case of Otitic Meningitis, with Histological Specimens of the Labyrinth demonstrating Streptococci *in situ*," Proceedings of the Royal Society of Medicine (Otological Section), 1908, vol. i. (illustrated).

"A Case of Cerebellar Abscess secondary to Infective Labyrinthitis, associated with Acute Inflammatory Œdema of the Brain: Recovery. Details of operative procedure." Proceedings of the Royal Society of Medicine (Otological Section), 1908, vol. ii.

"Observations on the Histology of the Human Labyrinth in Meningitis: Notes of Four Selected Cases, with Micro-Photographs of the Labyrinth," St. Bartholomew's Hospital Reports, 1908, vol. xliv. (illustrated).

"A Contribution to the Histology of the Human Osseous and Membranous Labyrinth, together with Observations on the Functions of the Human Labyrinth in Relation to Ocular Fixation," Journal of Anatomy and Physiology, 1909 (illustrated).

By the AUTHORS jointly.

"The Operative Surgery of Labyrinthitis, based upon an Experience of Thirty Cases," Proceedings of the Royal Society of Medicine (Otological Section), 1908, vol. i. (illustrated).

"A Case of Infective Meningitis secondary to Infection of the Labyrinth successfully treated by Translabyrinthine and Lumbar Drainage," Proceedings of the Royal Society of Medicine (Otological Section), 1908, vol. ii.

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